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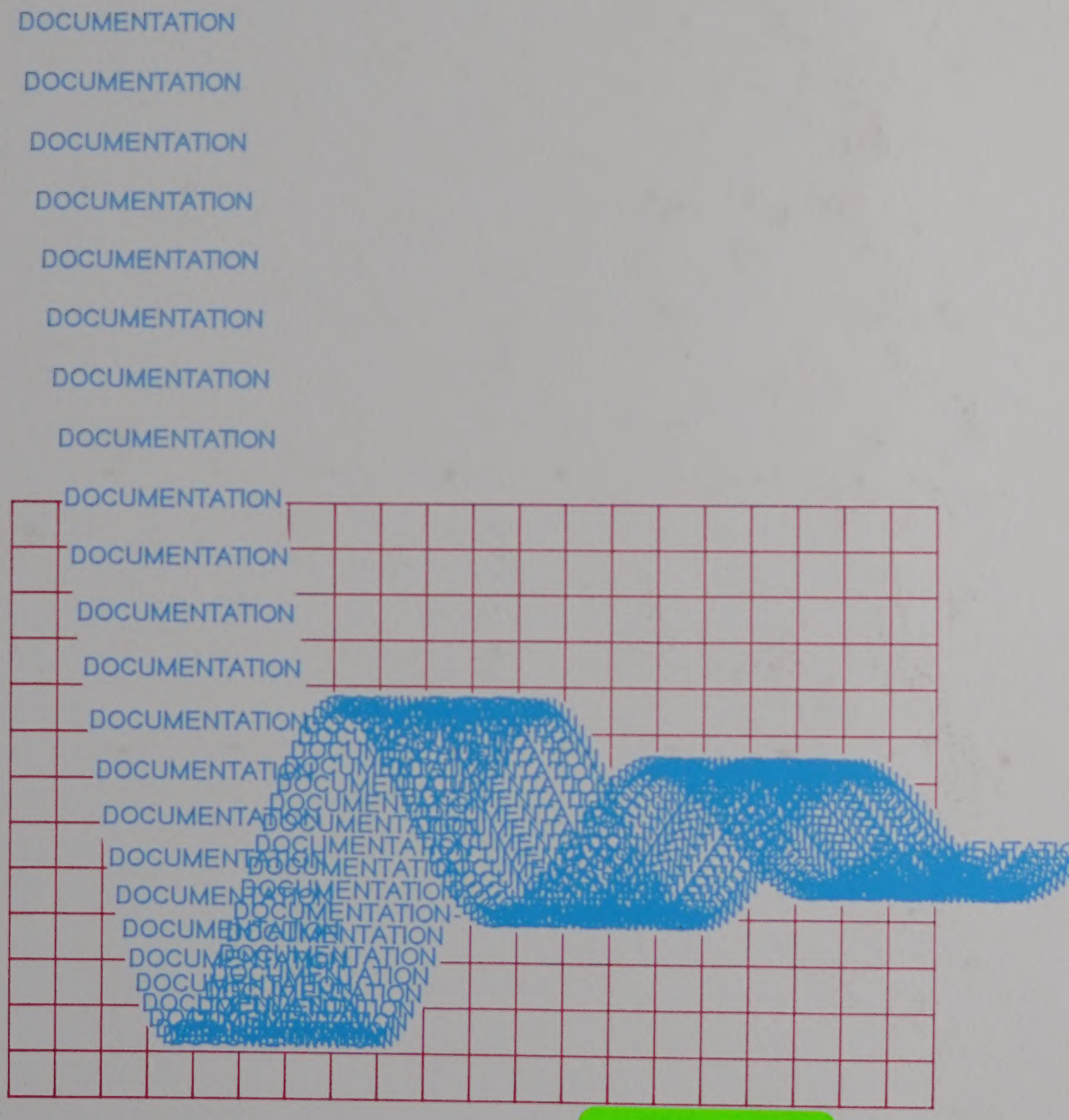

MP MASTER
MA20652

ROHDE&SCHWARZ

Test and Measurement
Division

Service Manual Instrument

SPECTRUM ANALYZER

FSU3
1129.9003.03

FSU8
1129.9003.08

Printed in the Federal
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Safety Instructions

This unit has been designed and tested in accordance with the EC Certificate of Conformity and has left the manufacturer's plant in a condition fully complying with safety standards.

To maintain this condition and to ensure safe operation, the user must observe all instructions and warnings given in this operating manual.

Safety-related symbols used on equipment and documentation from R&S:

Observe operating instructions

Weight indication for units >18 kg

PE terminal

Ground terminal

Danger! Shock hazard

Warning! Hot surfaces

Ground

Attention! Electrostatic sensitive devices require special care

1. The unit may be used only in the operating conditions and positions specified by the manufacturer. Unless otherwise agreed, the following applies to R&S products:

   IP degree of protection 2X, pollution severity 2 overvoltage category 2, only for indoor use, altitude max. 2000 m.

   The unit may be operated only from supply networks fused with max. 16 A.

   Unless specified otherwise in the data sheet, a tolerance of ±10% shall apply to the nominal voltage and of ±5% to the nominal frequency.

2. For measurements in circuits with voltages V_{rms} > 30 V, suitable measures should be taken to avoid any hazards.

   (using, for example, appropriate measuring equipment, fusing, current limiting, electrical separation, insulation).

3. If the unit is to be permanently wired, the PE terminal of the unit must first be connected to the PE conductor on site before any other connections are made. Installation and cabling of the unit to be performed only by qualified technical personnel.

4. For permanently installed units without built-in fuses, circuit breakers or similar protective devices, the supply circuit must be fused such as to provide suitable protection for the users and equipment.

5. Prior to switching on the unit, it must be ensured that the nominal voltage set on the unit matches the nominal voltage of the AC supply network.

   If a different voltage is to be set, the power fuse of the unit may have to be changed accordingly.

6. Units of protection class I with disconnectible AC supply cable and appliance connector may be operated only from a power socket with earthing contact and with the PE conductor connected.

7. It is not permissible to interrupt the PE conductor intentionally, neither in the incoming cable nor on the unit itself as this may cause the unit to become electrically hazardous.

   Any extension lines or multiple socket outlets used must be checked for compliance with relevant safety standards at regular intervals.

8. If the unit has no power switch for disconnection from the AC supply, the plug of the connecting cable is regarded as the disconnecting device. In such cases it must be ensured that the power plug is easily reachable and accessible at all times (length of connecting cable approx. 2 m). Functional or electronic switches are not suitable for providing disconnection from the AC supply.

   If units without power switches are integrated in racks or systems, a disconnecting device must be provided at system level.

9. Applicable local or national safety regulations and rules for the prevention of accidents must be observed in all work performed.

   Prior to performing any work on the unit or opening the unit, the latter must be disconnected from the supply network.

   Any adjustments, replacements of parts, maintenance or repair may be carried out only by authorized R&S technical personnel.

   Only original parts may be used for replacing parts relevant to safety (eg power switches, power transformers, fuses). A safety test must be performed after each replacement of parts relevant to safety.

   (visual inspection, PE conductor test, insulation-resistance, leakage-current measurement, functional test).

continued overleaf

10. Ensure that the connections with information technology equipment comply with IEC950 / EN60950.
11. Lithium batteries must not be exposed to high temperatures or fire.

    Keep batteries away from children.

    If the battery is replaced improperly, there is danger of explosion. Only replace the battery by R&S type (see spare part list).

    Lithium batteries are suitable for environmentally-friendly disposal or specialized recycling. Dispose them into appropriate containers, only.

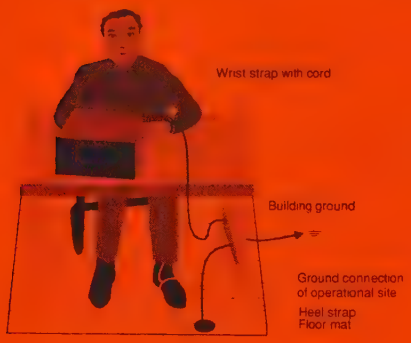
    Do not short-circuit the battery.
12. Equipment returned or sent in for repair must be packed in the original packing or in packing with electrostatic and mechanical protection.
13. Electrostatics via the connectors may damage the equipment. For the safe handling and operation of the equipment, appropriate measures against electrostatics should be implemented.
14. The outside of the instrument is suitably cleaned using a soft, lint-free dustcloth. Never use solvents such as thinners, acetone and similar things, as they may damage the front panel labeling or plastic parts.
15. Any additional safety instructions given in this manual are also to be observed.

Safety Instructions

The instrument contains components which are hazardous to electrostatic exposure and which are marked by the following symbol:

ACHTUNG: EGB!
Elektrostatisch gefährdete Bauelemente erfordern eine besondere Handhabung
ATTENTION ESD!
Electrostatic sensitive devices require a special handling

- To avoid damage of electronic components, the operational site must be protected against electrostatic discharge (ESD).

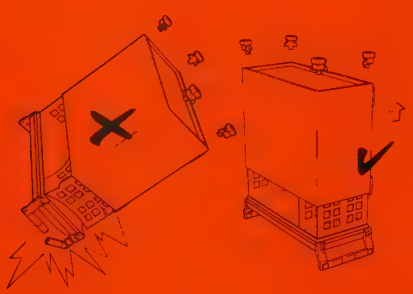


The following two methods of ESD protection may be used together or separately:

- Wrist strap with cord to ground connection
- Conductive floor mat and heel strap combination

The batteries used in the instrument are high-power lithium cells with a life utility of approx. 5 years. If you do not handle them properly, there is a danger of explosion. Therefore, observe the following safety instructions:

- Avoid short-circuit and loading of the battery
- Do not expose lithium batteries to high temperature or fire.
- Do not open used batteries
- Keep batteries away from children.
- Replace battery only by R&S type battery (R&S ordering number 0565.1687.00)
- Make sure to connect the battery to the appropriate terminals when replacing
- Lithium batteries are suitable for environmentally-friendly disposal or specialized recycling. Dispose them into appropriate containers, only.



- *Put the instrument on the front handles before loosing the rear feet and the tube to avoid damage of the instrument.*
- *When mounting the tube take care not to damage or pull off cables.*

Spare Parts Express Service

Phone: +49 89 4129 - 12465

Fax: +49 89 41 29 - 13306

E-mail:werner.breidling@rsd.rohde-schwarz.com

In case of urgent spare parts requirements for this Rohde & Schwarz unit, please contact our spare parts express service.

Outside business hours, please leave us a message or send a fax or e-mail. We shall contact you promptly.

Certified Quality System

ISO 9001

DQS REG. NO 1954-04

Sehr geehrter Kunde,

Sie haben sich für den Kauf eines Rohde & Schwarz-Produktes entschieden. Hiermit erhalten Sie ein nach modernsten Fertigungsmethoden hergestelltes Produkt. Es wurde nach den Regeln unseres Qualitätsmanagementsystems entwickelt, gefertigt und geprüft. Das Rohde & Schwarz-Qualitätsmanagementsystem ist nach ISO 9001 zertifiziert.

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The Rohde & Schwarz quality management system is certified according to ISO 9001.

Cher client,

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Contents of Manuals for Spectrum Analyzer FSU

Service Manual - Instrument

The service manual - instrument informs on how to check compliance with rated specifications, on instrument function, repair, troubleshooting and fault elimination. It contains all information required for repairing the FSU by the replacement of modules.

The service manual comprises four chapters and an annex (chapter 5) containing the FSU circuit documentation:

Chapter 1 provides all the information necessary to check FSU for compliance with rated specifications. The required test equipment is included, too.

Chapter 2 describes the manual adjustment of the calibration source and of the frequency accuracy as well as the automatic adjustment of individual module data following module replacement.

Chapter 3 describes the design of FSU as well as simple measures for repair and fault diagnosis, in particular, the replacement of modules.

Chapter 4 contains information on the extension and modification of FSU by installing instrument software and retrofitting options.

Chapter 5 describes the shipping of the instrument and ordering of spare parts and contains spare parts lists and exploded views of FSU.

Operating Manual

In the operating manual for FSU you will find information about the technical specifications of FSU, the controls and connectors on the front and rear panel, necessary steps for putting the instrument into operation, the basic operating concept, manual and remote control.

For introduction typical measurement tasks are explained in detail using the functions of the user interface and program examples.

The operating manual further provides hints on preventive maintenance and fault diagnosis by means of warnings and error messages output by the unit.

Service and Repair

Please contact your Rohde & Schwarz support center or our spare parts express service if you need service or repair of your equipment or to order spare parts and modules.

The list of the Rohde & Schwarz representatives and the address of our spare parts express service are provided at the beginning of this service manual.

We require the following information in order to answer your inquiry fast and correctly and to decide whether the warranty still applies for your instrument:

- Instrument model
- Serial number
- Firmware version
- Detailed error description in case of repair
- Contact partner for checkbacks

Rohde & Schwarz offers the following calibrations:

- Calibration on R&S-type test systems. The calibration documentation meets the requirements of the quality management system ISO 9000.
- Calibration at an R&S calibration center approved by the German Calibration Service (DKD). The calibration documentation consists of the DKD calibration certificate.

Refer to Chapter 5 for a detailed description on shipping of the instrument and ordering of spare parts.

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1 Performance Test

Test Instructions

- The rated specifications of the analyzer are tested after a warm-up time of at least 15 minutes and overall calibration. Only in this case can the compliance with the guaranteed data be ensured. Starting of overall adjustment: [*CAL : CAL TOTAL*]
- If nothing else specified, all measurements will be done with external reference frequency.
- Values given in the following sections are not guaranteed. Only the technical specifications of the data sheet are binding.
- The values given in the datasheet are the guaranteed limits. Due to measurement errors these limits must be extended by the tolerance of the measuring equipment used in this performance test.
- Inputs for settings during measurements are shown as following:

  [**<KEY>**] Press a key on the front panel, eg **[SPAN]**

  [<SOFTKEY>] Press a softkey, eg [MARKER -> PEAK]

  [**<nn unit>**] Enter a value and terminate by entering the unit, eg [**12 kHz**]

  Successive entries are separated by [:], eg. [**BW** : RES BW MANUAL : **3 kHz**]

Measuring Equipment and Accessories

Item	Type of equipment	Specifications recommended	Equipment recommended	R&S Order No.	Use
1	Frequency counter	accuracy < $1x10^{-9}$, frequency range up to 10 MHz	Advantest R5361B with option 23		Frequency Accuracy of Reference Oscillator
2	Signal generator	1 MHz - 13 GHz	SMP02	1035.5005.02	Immunity to Interference Third-Order Intercept Frequency Response
3	Signal generator	1 MHz - 3.6 GHz Phase noise at 640 MHz: < -100 dBc/Hz @ 100 Hz < -115 dBc/Hz @ 1 kHz < -127 dBc/Hz @ 10 kHz < -130 dBc/Hz @ 100 kHz < -142 dBc/Hz @ 1MHz	SMHU	0835.8011.52	Calibration Source 128 MHz 2nd-Order Harmonic Dist. Third-Order Intercept IF Filters Frequency Response Display Linearity RF Attenuator Reference Level Switching Phase Noise
4	Signal generator	FSU 8: 3.6 GHz to 8 GHz	SMP02	1035.5005.02	Third-Order Intercept
5	3-dB coupler (power combiner)	FSU 3: 10 MHz to 3.6 GHz FSU 8: 10 MHz to 8 GHz			Third-Order Intercept
6	6-dB divider (power splitter)	FSU 3: 10 MHz to 3.6 GHz FSU 8: 10 MHz to 8 GHz			Frequency Response
7	50-Ω termination	Return loss > 20 dB FSU 3: to 3.6 GHz FSU 8: to 8 GHz	 RNA RNA	 0272.4510.50 0272.4510.50	Noise Display
8	Power meter		NRVD	0857.8008.02	Frequency Response
9	Power sensor	1 MHz to 3 GHz RSS ≤ 0.8% Meter noise ≤ 20 pW	NRV-Z4	0828.3618.02	Frequency Response

Item	Type of equipment	Specifications recommended	Equipment recommended	R&S Order No.	Use
10	Power sensor	RSS referred to indicated Power: 1 MHz to 1 GHz ≤1.5 % 1 GHz to 7 GHz ≤2 % 7 GHz to 8 GHz ≤3.5 % FSU 3: 10 MHz to 3.6 GHz FSU 8: 10 MHz to 8 GHz	 NRV-Z4 NRV-Z4	 0828.3218.02	Frequency Response
11	Step attenuator	variable attenuation 0 dB to 100 dB, 1-dB steps attenuation accuracy < 0.1 dB (f = 5 MHz)	RSP	0831.3515.02	Reference Level Switching Display Linearity RF Attenuator
12	Attenuator (2 x)	fixed attenuation 10 dB FSU 3: 10 MHz to 3.6 GHz FSU 8:: 10 MHz to 8 GHz	 DNF DNF	 0272.4210.50 0272.4210.50	Third-Order Intercept
13	Lowpass[1)]	cut-off frequency: 28 MHz, 107 MHz, 262 MHz, 640 MHz, 1000 MHz, 1700 MHz			2nd-Order Harmonc Dist.
14	VSWR-Bridge	 FSU 3 : 10 MHz to 3,6 GHz FSU 8: 10 MHz to 7 GHz	 ZRC Wiltron 87A50 with adapter 34AN50, Open/Short 22NF50	1039.9492.55	VSWR

1) The lowpass filters improve the harmonics suppression of the test signal. If the harmonics suppression at the signal generator output is already large enough, no filters are required for the frequency ranges concerned (see section "Checking Imunity to Interference" for harmonics suppression required)

Performance Test FSU

Checking the Reference Frequency Accuracy

Test equipment:

Frequency counter (Section "Measurement Equipment", item 1):
accuracy < $1x10^{-9}$
frequency range up to 10 MHz

Test setup:

➢ connect frequency counter to 10-MHz reference output of the FSU (rear panel)

FSU settings:

- [**SETUP** : REFERENCE INT / EXT]
➢ toggle to internal reference (INT)

Measurement:

➢ measure frequency with frequency counter

nominal frequency:
model without option FSU-B4 ..... 10 MHz ± 1 Hz
.. model with option FSU-B4 .....10 MHz ±0.3Hz

Note:

The frequency of the reference oscillator can be adjusted by means of a service function (see chapter "Adjustment")

Checking Imunity to Interference

Test equipment:

Signal generator (Section "Measurement Equipment", item 2):
frequency range FSU 3: 10 MHz to 13 GHz
FSU 8: 10 MHz to 13 GHz
maximum level ≥ 0 dBm

Test setup:

➢ connect RF output of the signal generator to RF input.

Signal generator settings:

Level: adjust the output level of signal generator for an RF-Input level of 0 dBm

FSU settings:

- [**PRESET**]
- [**AMPT** : RF ATTEN MANUAL : **0 dB**]
- [**AMPT** : REF LEVEL : **-30 dBm**]
- [**SPAN** : **100 kHz**]
- [**BW** : RES BW MANUAL : **3 kHz**]

1st IF Image Frequency Rejection

Additional signal generator settings: - frequency f_{in} + 9256.8 MHz

Additional FSU settings: - [**FREQ** : CENTER : {f_{in}}]

See table of performance test report for values of f_{in}

Measurement: ➢ Set marker to peak of signal
[**MKR** ⇒ : PEAK]

Evaluation: The image frequency rejection is the difference between the output level of the signal generator and the level reading of marker 1 (L_{dis}):
Image frequency rejection = 0dBm – L_{dis}

2nd IF Image Frequency Rejection

Additional signal generator settings: - frequency f_{in} + 808.8 MHz

Additional FSU settings: - [**FREQ** : CENTER : {f_{in}}]

See table of performance test report for values of f_{in}.

Measurement: ➢ Set marker to peak of signal
[**MKR** ⇒ : PEAK]

Evaluation: The image frequency rejection is the difference between the output level of the signal generator and the level reading of marker 1 (L_{dis}):
Image frequency rejection = 0dBm – L_{dis}

3rd IF Image Frequency Rejection

Additional signal generator settings: - frequency f_{in} + 40.8 MHz

Additional FSU settings: - [**FREQ** : CENTER : {f_{in}}]

See table of performance test report for values of f_{in}.

Measurement: ➢ Set marker to peak of signal
[**MKR** ⇒ : PEAK]

Evaluation: The image frequency rejection is the difference between the output level of the signal generator and the level reading of marker 1 (L_{dis}):
Image frequency rejection = 0dBm – L_{dis}

1st IF Rejection

Additional signal generator settings: - frequency 4628.4 MHz

Additional FSU settings: - [**FREQ** : CENTER : {f_{in}}]

See table of performance test report for values of f_{in}.

Measurement: ➢ Set marker to peak of signal
- [**MKR** ⇒ : PEAK]

Evaluation: The IF rejection is the difference between the output level of the signal generator and the level reading of marker 1 (L_{dis}):

IF rejection = 0dBm – L_{dis}

2nd IF Rejection

Additional signal generator settings: - frequency 404.4 MHz

Additional FSU settings: - [**FREQ** : CENTER : {f_{in}}]

See table of performance test report for values of f_{in}.

Measurement: ➢ Set marker to peak of signal
- [**MKR** ⇒ : PEAK]

Evaluation: The IF rejection is the difference between the output level of the signal generator and the level reading of marker 1 (L_{dis}):

IF rejection = 0dBm – L_{dis}

Checking Non-linearities

Third-Order Intercept Point

Test equipment:

- 2 signal generators
  - FSU 3: Section "Measurement Equipment", item 2 and 3
  - FSU 8 Section "Measurement Equipment", item 2, 3, 4
  - frequency range:
    - FSU 3: 10 MHz to 3.6 GHz
    - FSU 8: 10 MHz to 8 GHz
  - Maximum level ≥ 0 dBm
- 2 attenuators (Section "Measurement Equipment", item 12)
  - attenuation a_{ATT} = 10 dB
  - frequency range
    - FSU 3: 10 MHz to 3.6 GHz
    - FSU 8: 10 MHz to 8 GHz
- 3-dB coupler (Section "Measurement Equipment", item 5)
  - frequency range
    - FSU 3: 10 MHz to 3.6 GHz
    - FSU 8: 10 MHz to 8 GHz
  - decoupling > 12 dB

Test setup:

- ➢ Connect RF outputs of the signal generators via 10-dB attenuators to the inputs of the 3-dB coupler
- ➢ Connect output of the 3-dB coupler to RF input of the FSU.

Signal generator settings: (both generators)

- frequency: generator 1 $f_{g1} = f_{in} - 50$ kHz
  generator 2 $f_{g2} = f_{in} + 50$ kHz

See table of performance test report for values of f_{in}

- ➢ Adjust the output level of signal generators for an input level at the FSU of –10 dBm.
- ➢ Switch off the ALC of the generators to reduce the interference between the generators

FSU settings:

- [**PRESET**]
- [**AMPT** : RF ATTEN MANUAL : **0 dB**]
- [**AMPT** : **0 dBm**]
- [**SPAN** : **500 kHz**]
- [**BW** : RES BW MANUAL : **3 kHz**]
- [**FREQ** : CENTER : {f_{in}}]

See table of performance test report for values of f_{in}

Measurement

- ➢ [**MKR FCTN** : TOI]

Evaluation:

The third order intercept point (T.O.I) referred to the input signal is displayed in the marker field by the reading [TOI].

Second-Order Harmonic Distortion

Test equipment:

- Signal generator (Section "Measurement Equipment", item 3)

frequency range:
FSU 3 / 8: 9 kHz to 1.8 GHz

Recommended harmonic suppression:
f <100 MHz : >35 dBc
100 MHz < f < 1 GHz : >45 dBc
f >1 GHz : >35 dBc

In order to improve the harmonic suppression of the generator it is recommended to insert a lowpass filter with a suitable cut-off frequency (Section "Measurement Equipment", item 13) after the generator.

Test setup:

➢ connect RF output of signal generator to the input of the lowpass

➢ connect the output of the lowpass to the RF input of the FSU

Note:

If the harmonic suppression of the signal generator is sufficient, the lowpass can be left out.
The RF output of the generator can be connected directly to the RF input of the FSU in this case.

Signal generator settings:

- level:0 dBm
- frequency: f_{in}

see table of performance test report for values of f_{in}

FSU settings:

- [**PRESET**]
- [**AMPT** : RF ATTEN MANUAL : **0 dB**]
- [**AMPT** : **0 dBm**]
- [**SPAN** : **3 kHz**]
- [**BW** : RES BW MANUAL : **1 kHz**]
- [**FREQ :** CENTER : { f_{in} }]

See table of performance test report for values of f_{in}

Measurement:

➢ set marker to peak of signal
- [**MKR** ⇒ : PEAK]

The level of the input signal L_{IN} is displayed by the marker reading for marker 1.

➢ set center frequency of the FSU to the frequency of the 2nd harmonic
- [**FREQ** : CENTER : {2 x f_{in}}]

Measurement:

➢ set marker to peak of the 2nd harmonic
- [**MKR** ⇒ : PEAK]

The level of the harmonic signal L_{K2} is displayed by the marker reading for marker 1.

Evaluation:

The second order harmonic distortion can be calculated as

$$IP_{k2} / dBm = (L_{IN} - L_{K2}) + L_{IN}$$

Checking IF Filters

Test equipment: Signal generator (Section "Measurement Equipment", item 3):
frequency 128 MHz
level ≥ 0 dBm

Test setup: ➢ connect RF output of the signal generator to the RF input of the FSU.

Checking the bandwidth switching level accuracy

Reference measurement (RBW 10 kHz)

Signal generator settings:
- frequency: 128 MHz
- level:-30 dBm

FSU settings:
- [**PRESET**]
- [**AMPT** : **-30 dBm**]
- [**AMPT** : RF ATTEN MANUAL : **10 dB**]
- [**FREQ** : CENTER : **128 MHz**]
- [**SPAN** : **5 kHz**]
- [**TRACE** : DETECTOR : RMS]
- [**BW** : RBW MANUAL : **10** : **kHz**]

Reference measurement:
➢ Set marker to peak of signal
- [**MKR** ⇒ : PEAK]

➢ Set reference to peak of signal
- [**MKR** : REFERENCE FIXED]

Checking the level accuracy

FSU settings:
- [**SPAN** : {0.5 x RBW}]
- [**BW** : RBW MANUAL : {RBW} : **ENTER**]

Note:
To check the FFT- filter, the resolution bandwidth has to be set manually to FFT-Mode.

- [**BW** : BW MODE : FFT]

Measurement:
➢ set marker to peak of signal
- [**MKR** ⇒ : PEAK]

Evaluation: The level difference is displayed in the marker field by the reading ´Delta [T1 FXD] {xxx} dB´.

Checking Bandwidth

Signal generator settings:
- frequency: 128 MHz
- level:-10 dBm

FSU settings:
- [**PRESET**]
- [**AMPT** : RF ATTEN MANUAL : **10 dB**]
- [**AMPT** : **0 dBm**]
- [**FREQ** : CENTER : **128 MHz**]
- [**BW** : COUPLING RATIO : SPAN/RBW MANUAL : **3** : **ENTER**]

➢ Determine 3-dB-Bandwith
- [**MKR FCTN** : N DB DOWN : **3 dB**]
- [**SPAN** : {3 x RBW}]

See table of performance test report for values of RBW.

Note:

To check the filters > 3 MHz, the resolution bandwidth has to be set manually to X MHz. All other bandwidths will be set automatically by changing the span.

- [**BW** : RES BW MANUAL : **X MHz**] , with X = 5, 10, 20 or 50 MHz

Measurement:
- [**MKR** ⇒ : PEAK]

The 3-dB bandwidth is displayed by the reading ´BW {bandwidth}´.

Checking the Shape Factor

Note: *To check the shape factor the values of the 3 dB bandwith will be needed. Please check before this measurement.*

Signal generator settings:
- frequency: 128 MHz
- level:0 dBm

FSU settings:
- [**PRESET**]
- [**AMPT** : RF ATTEN MANUAL : **10 dB**]
- [**AMPT** : **0 dBm**]
- [**FREQ** : CENTER : **128 MHz**]
- [**BW** : COUPLING RATIO : SPAN/RBW MANUAL : **20 ENTER**]
- [**BW** : COUPLING RATIO : RBW/VBW NOISE [10]]
- [**MKR FCTN** : N DB DOWN : **60 dB**]
- [**SPAN** : {20 x RBW}]

See table of performance test report for values of RBW.

Note:

To check the filters > 3 MHz, the resolution bandwidth has to be set manually to X MHz. All other bandwidths will be set automatically by changing the span.

- [**BW** : RES BW MANUAL : **X MHz**] , with X = 5, 10, 20 or 50 MHz

Measurement:
- [**MKR** ⇒ : PEAK]

The 60 dB bandwidth is displayed by the reading ´BW {bandwidth}´.

Evaluation: The shape factor is calculated by BW (60dB) / BW (3dB).

Checking Noise Display

Test equipment: 50-Ω termination (Section "Measurement Equipment", item 7)
frequency range FSU 3: to 3.6 GHz
FSU 8: to 8 GHz

Test setup: ➢ terminate the RF input of the FSU with 50 Ω

FSU settings:

Measurement for $f_n \leq$ 1 kHz:
- [**PRESET**]
- [**AMPT** : RF ATTEN MANUAL : **0 dB**]
- [**SPAN** : **10 Hz**]
- [**BW** : BW MODE : **FFT**]
- [**BW** : RES BW MANUAL : **10 Hz**]
- [**TRACE 1** : AVERAGE]
- [**TRACE 1** : SWEEP COUNT : **30 ENTER**]
- [**AMPT** : {RefLev}]
- [**FREQ** : CENTER : {f_n}]

Measurement for f_n >1 kHz:
- [**PRESET**]
- [**AMPT** : RF ATTEN MANUAL : **0 dB**]
- [SPAN : 0 Hz]
- [**BW** : RES BW MANUAL : **1 kHz**]
- [**BW** : SWEEP TIME MANUAL : **50 ms**]
- [**TRACE 1** : AVERAGE]
- [**TRACE 1** : SWEEP COUNT : **30 ENTER**]
- [**AMPT** : {RefLev}]
- [**FREQ** : CENTER : {f_n}]
- [**MEAS** : Time Dom Power : **Mean**]

See table below for values of RefLev.

See table of performance test report for values of f_n.

Measurement: Set the marker to the center frequency for the value below or equal 1 kHz, read out the mean marker for frequencies above 1 kHz.

Evaluation: The noise level is displayed by the level reading of marker 1.

Frequency	< 10kHz	< 100kHz	< 1MHz	< 10MHz	> 10kHz
RefLev	-10 dBm	-20 dBm	-30 dBm	-60 dBm	-60 dBm

Checking the Level accuracy and the Frequency Response

Test equipment:

- Signal generator :
  FSU 3: Section "Measurement Equipment", item 3
  FSU 8: Section "Measurement Equipment", item 3 and 4

  frequency range FSU 3: to 3.6 GHz
  FSU 8: to 8 GHz

  maximum level ≥ 0 dBm

- power meter (Section "Measurement Equipment", item 8)

- power sensor :
  FSU 3: Section "Measurement Equipment", item 9
  FSU 8 / 13 /30: Section "Measurement Equipment", item 9 and 10

  frequency range FSU 3: to 3.6 GHz
  FSU 8: to 8 GHz

  maximum power $P_{max} \geq 100\ \mu W$

  RSS referred to indicated power 1 MHz to 1 GHz .....≤ 1.5 %
  1 GHz to 7 GHz .....≤ 2 %
  7 GHz to 8 GHz .....≤ 3.5 %

  impedance Z = 50 Ω

- 6-dB divider (Section "Measurement Equipment", item 6)

  frequency range FSU 3: to 3.6 GHz
  FSU 8: to 8 GHz

  level imbalance[1]) 1 MHz to 3.6 GHz ≤ 0.1 dB
  3.6 GHz to 8 GHz ≤ 0.2 dB

  [1]) If a power splitter with higher level imbalance is used correction of the measured frequency response is recommended.

Determining the level accuracy at 128 MHz

Test setup:

- ➢ connect power sensor (item 9) to the power meter and execute function 'ZERO' when there is no signal applied to the power sensor
- ➢ connect power sensor to RF output of signal generator

Signal generator settings:

- frequency 128 MHz
- level -30 dBm

Measurement:

- ➢ determine output power of the signal generator with the power meter
- ➢ connect RF output of the signal generator to RF input of the FSU

FSU settings:

- [**PRESET**]
- [**AMPT** : RF ATTEN MANUAL : **10 dB**]
- [**AMPT** : **-30 dBm**]
- [**SPAN** : **30 kHz**]
- [**BW** : RES BW MANUAL : **10 kHz**]
- [**TRACE** : DETECTOR : RMS]
- [**FREQ** : CENTER : **128 MHz**]

➢ set marker to peak of signal
- [**MKR** ⇒ : PEAK]

Evaluation:

The difference between the signal levels measured with the power meter and the FSU (level reading of marker 1) reflects the absolute level accuracy of the FSU. It can be calculated as:

$$\text{Level accuracy}_{128\text{MHz}} = L_{\text{FSU}} - L_{\text{powermeter}}$$

Checking the frequency response

Test setup:

- ➢ connect RF output of the signal generator to input of the divider
- ➢ connect output 1 of the divider to the power sensor / power meter
- ➢ connect output 2 of the divider to RF input of the FSU

Signal generator settings:

- level 0 dBm
- frequency 128 MHz

FSU settings:

- [**PRESET**]
- [**AMPT** : RF ATTEN MANUAL : **10 dB**]
- [**AMPT** : **0 dBm**]
- [**SPAN** : **100 kHz**]
- [**BW** : RES BW MANUAL : **10 kHz**]
- [**TRACE** : DETECTOR : RMS]
- [**FREQ** : CENTER : **128 MHz**]

Reference measurement:

- ➢ Determine signal level $L_{powermeter}$.
- ➢ set marker to peak of signal
- [**MKR** ⇒ : PEAK]

The signal level L_{FSU} is displayed by the level reading of marker 1.

$$Ref_{128MHz} = L_{FSU} - L_{powermeter}$$

Measurement

Signal generator settings:

- frequency f_{fresp}

see table of performance test report for values of f_{fresp}

Power meter settings:

Determine signal level $L_{powermeter}$. To achive higher accuracy it is Recommended to compensate the frequency response of the power sensor.

FSU settings:

- [**FREQ** : CENTER : {f_{fresp}}]

see table of performance test report for values of f_{fresp}

- ➢ - set marker to peak of signal
- [**MKR** ⇒ : PEAK]

The signal level L_{FSU} is displayed by the level reading of marker 1.

Evaluation:

The frequency response can be calculated as:

$$\text{Frequency response} = L_{FSU} - L_{powermeter} - Ref_{128\ MHz}$$

Checking the Display Linearity

Test equipment:

- Signal generator (Section "Measurement Equipment", item 3)
  frequency 5 MHz [1)]
  maximum level ≥ 10 dBm
- step attenuator (Section "Measurement Equipment", item 11)
  frequency 5 MHz [1)]
  attenuation 0 to 100 dB in 1 dB steps
  attenuation accuracy < 0.1 dB

Test setup:

➢ connect RF output of the signal generator to RF input of the step attenuator

➢ connect RF output of the step attenuator to RF input of the FSU

Signal generator settings:

- frequency 5 MHz [1)]
- level +10 dBm

Step attenuator settings:

Attenuation 20 dB

FSU settings:

- [**PRESET**]
- [**AMPT** : RF ATTEN MANUAL : **10 dB**]
- [**AMPT** : **0 dBm**]
- [**FREQ** :CENTER : **5 MHz**]
- [**SPAN** : **0 Hz**]
- [**TRACE** : DETECTOR : RMS]

1.Measurement:
- [**BW** : RES BW MANUAL : **500 Hz**]

2.Measurement:
- [**BW** : RES BW MANUAL : **300 kHz**]

3.Measurement:
- [**BW** : RES BW MANUAL : **20 MHz**]

Reference measurement:

➢ set marker to peak of signal
- [**MKR** ⇒ : PEAK]

➢ set reference to peak of signal
- [**MKR** : REFERENCE FIXED]

Measurement

Step attenuator settings:

Attenuation $\{a_{ATT}\}$

See table of performance test report for values of a_{ATT}.

Evaluation:

The difference between the level of the input signal of the FSU and the reference (about 10 dB below the reference level) is displayed in the marker field by the reading ´Delta [T1 FXD]´.

[1)] A frequency between 5 MHz and 1 GHz may be used. It is recommended to use correction values for the uncertainty of the attenuator.

Checking the RF Attenuator

Test equipment:

- Signal generator (Section "Measurement Equipment", item 3)
  frequency 128 MHz
  maximum level ≥ 0 dBm

- step attenuator (Section "Measurement Equipment", item 11)
  frequency 128 MHz
  attenuation 0 to 80 dB in 5 dB steps
  attenuation accuracy < 0.1 dB

Test setup:

➢ connect RF output of the signal generator to RF input of the step attenuator
➢ connect RF output of the step attenuator to RF input of the FSU

Signal generator settings:

- Frequency 128 MHz
- Level 0 dBm

Step attenuator settings: Attenuation 70 dB

FSU settings:

- [**PRESET**]
- [**FREQ** : CENTER : **128 MHz**]
- [**SPAN** : **500 Hz**]
- [**BW** : RES BW MANUAL : **1 kHz**]
- [**TRACE** : DETECTOR : RMS]
- [**BW** : VIDEO BW MANUAL : **100 Hz**]
- [**AMPT** : RF ATTEN MANUAL : **10 dB**]
- [**AMPT** : **-30 dBm**]

Reference measurement:

➢ set marker to peak of signal
- [**MKR** ⇒ : PEAK]

➢ set reference to peak of signal
- [**MKR** : REFERENCE FIXED]

Measurement

Step attenuator settings: Attenuation { 80dB - a_{FSU} }
See table below for values of a_{ATT}.

FSU settings:

- [**AMPT** : RF ATTEN MANUAL : { a_{FSU} }]
- [**AMPT** : {-40dBm + a_{FSU} } **dBm**]
- [**MKR** ⇒ : PEAK]

see table below for values of a_{FSU} , a_{ATT} and reference level.

Evaluation:

The difference between the level of the input signal of the FSU and the reference (at 10 dB RF-Attenuation) is displayed in the marker field by the reading ´Delta [T1 FXD]´.

a_{ATT}	80 dB	75 dB	70 dB	60 dB	40 dB
a_{FSU}	0 dB	5 dB	10 dB	20 dB	40 dB
reference level	-40 dBm	-35 dBm	-30 dBm	-20 dBm	0 dBm

Checking the Reference Level Switching (IF-Gain)

Test principle:

The IF gain of the FSU can be switched from 0 to 50 dB by changing the reference level at fixed RF attenuation. To prevent the IF gain accuracys to be mixed up with the log amplifier accuracy it is determined by comparison using an external precision attenuator.

Test equipment:

- Signal generator (Section "Measurement Equipment", item 3)
  frequency 5 MHz
  maximum level ≥ -10 dBm
- step attenuator (Section "Measurement Equipment", item 11)
  frequency 5 MHz
  attenuation 0 to 60 dB in 1 dB steps
  attenuation accuracy < 0.1 dB

Test setup:

➢ connect RF output of the signal generator to RF input of the step attenuator

➢ connect RF output of the step attenuator to RF input of the FSU

Signal generator settings:

- frequency 5 MHz
- level -10 dBm

Step attenuator settings:

Attenuation 20 dB

FSU settings:

- [**PRESET**]
- [**FREQ** : CENTER : **5 MHz**]
- [**SPAN** : **2 kHz**]
- [**BW** : RES BW MANUAL : **1 kHz**]
- [**BW** : VIDEO BW MANUAL : **100 Hz**]
- [**TRACE** : DETECTOR : RMS]
- [**AMPT** : RF ATTEN MANUAL : **10 dB**]
- [**AMPT** : **-10 dBm**]

Reference measurement:

➢ set marker to peak of signal
- [**MKR** ⇒ : PEAK]

➢ set reference to peak of signal
- [**MKR** : REFERENCE FIXED]

Measurement

Step attenuator settings: Attenuation $\{a_{ATT}\}$

See table below for values of a_{ATT}.

FSU settings: - [**AMPT** : {reference level} **dBm**]

see table below for values of reference level.

- [**MKR** ⇒ : PEAK]

Evaluation: The difference between the level of the input signal of the FSU and the reference (at 10 dB IF-Gain) is displayed in the marker field by the reading ´Delta [T1 FXD]´.

10-dB gain steps:

a_{ATT}	10 dB	20 dB	30 dB	40 dB	50 dB	60 dB
reference level	0 dBm	-10 dBm	-20 dBm	-30 dBm	-40 dBm	-50 dBm

1-dB gain steps:

a_{ATT}	20 dB	21 dB	22 dB	23 dB	24 dB	25 dB	26 dB	27 dB	28 dB	29 dB
reference level	-10 dBm	-11 dBm	-12 dBm	-13 dBm	-14 dBm	-15 dBm	-16 dBm	-17 dBm	-18 dBm	-19 dBm

Checking the Phase Noise

Test equipment:

Signal generator (Section "Measurement Equipment", item 3)

frequency	640 MHz
level	≥ 0 dBm
Phase Noise at 640 MHz:	< -100 dBc/Hz @ 100 Hz
	< -115 dBc/Hz @ 1 kHz
	< -127 dBc/Hz @ 10 kHz
	< -130 dBc/Hz @ 100 kHz
	< -142 dBc/Hz @ 1MHz

Test setup:

➢ connect RF output of the signal generator to RF input of the FSU

Signal generator settings:

- frequency 640 MHz
- level 0 dBm

Fineadjust the frequency of the generator so that the FSU shows exactly 640 MHz .

FSU settings:

- [**PRESET**]

- [**FREQ** : CENTER : **640 MHz**]
- [**AMPT** : **0 dBm**]
- [**AMPT** : RF ATTEN MANUAL : **10 dB**]
- [**SPAN** : {span}]

  depending on offset, see table below for values of span.

- [**BW** : COUPLING RATIO : RBW/VBW NOISE[10]]
- [**BW** : RBW MANUAL : {RBW}]

  depending on offset, see table below for values of RBW.

- [**TRACE 1** : AVERAGE]
- [**SWEEP** : SWEEP COUNT : **20** : **ENTER**]

➢ activate phase noise marker

- [**MKR FCTN**: PHASE NOISE]

- [**FREQ** : CENTER : {640 MHz + offset}]

  see table below for values of offset.

- [**AMPT** : {reference level}]

  depending on offset, see table below for values of reference level.

- [**AMPT** : RF ATTEN MANUAL : {a_{FSU}}]

  depending on offset, see table below for values of a_{FSU} .

➢ set Phase Noise Marker
[**MKR :** MARKER 2 : {offset}]

see table below for values of offset.

***Note**: Please make sure not to measure on a spurious signal.*

Evaluation:

The Phase Noise is displayed in the marker field by the reading ´Delta 2 [T1 PHN]´.

Phase noise measurement settings				
Offset	**Span**	**RBW**	**Reference Level**	**a_{FSU}**
100 Hz	20 Hz	30 Hz	0 dBm	10 dB
1 kHz	200 Hz	100 Hz	0 dBm	10 dB
10 kHz	2 kHz	300 Hz	0 dBm	10 dB
100 kHz	10 kHz	3 kHz	-10 dBm	0 dB
1 MHz	100 kHz	30 kHz	-30 dBm	0 dB

Note: *To obtain a precise measurement of the phase noise at high offsets the level used at the FSU input is 10 to 30 dB higher than the reference level. To reduce the measurement time the phase noise is measured with a small span around the frequency offset. This prevents the FSU from being overloaded.*

Checking the Return Loss at the RF Input

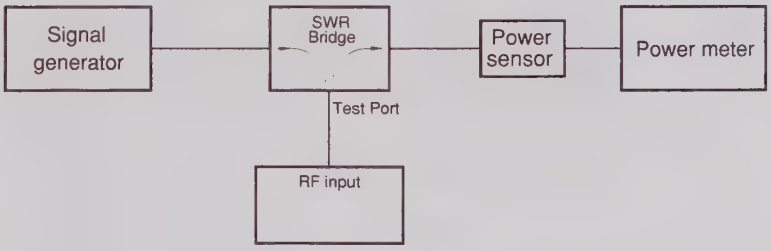
Test equipment:

FSU 3 / FSU 8:

- Signal generator (Section "Measurement Equipment", item 2)
  - frequency range FSU 3: 10 MHz bis 3,6 GHz
    FSU 8 10 MHz bis 8 GHz
  - level range ≥ -10 dBm
- power meter (Section "Measurement Equipment", item 8)
- power sensor
  - frequency range FSU 3: 10 MHz to 3,6 GHz
    FSU 8 10 MHz to 7 GHz
- SWR-bridge (Section "Measurement Equipment", item 14)
  - frequency range FSU 3: 10 MHz to 3,6 GHz
    FSU 8 10 MHz to 7 GHz

Test setup:

FSU 3 / FSU 8:



Signal generator settings:

- level -10 dBm
- frequency $\{f_{in}\}$

See performance test report for values of f_{in}.

FSU settings:

- [**SYSTEM PRESET**]
- [**INPUT** : RF ATTEN MANUAL : **10 dB**]

Calibration:

FSU 3 / FSU 8:

Use total reflection (OPEN or SHORT) at the test port of the SWR bridge as a reference:

Remove cable from RF input of the FSE and connect precision short or open to the cable. Determine reflected power with the power meter and store measured level LRef as reference. Repeat this procedure for every measurement over the whole frequency range.

Measurement:

FSU 3 / FSU 8:
Connect the RF input of the FSE to the test port of the SWR bridge. Measure reflected power L_r with the power meter. The return loss a_r of the RF input of the FSE can be calculated as:

$$a_r = L_{Ref} - L_r .$$

The VSWR can be calculated as:

$$s = \frac{10^{0.05a_r} + 1}{10^{0.05a_r} - 1} .$$

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Performance Test Report FSU

Table 1-1 Performance Test report

ROHDE & SCHWARZ	Performance Test Report	Spectrum Analyzer FSU	Version 27-Jul-00
Model (FSU-3/ 8):			
Order number:	1129.9003.		
Serial number:			
Test person:			
Date:			
Sign:			

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
Frequency accuracy Reference oscillator	Page 1.3					
Model w/o Opt. B4		9.999999	_____	10.000001	MHz	
Model with Opt. B4		9.9999997	_____	10.0000003	MHz	
Image frequency rejection,1st IF, f_{in}	Page 1.4					
11 MHz		90	_____	-	dB	
100 MHz		90	_____	-	dB	
1701 MHz		90	_____	-	dB	
3001 MHz		90	_____	-	dB	
image frequency rejection 2nd IF, f_{in}	Page 1.4					
FSU 3 / 8:						
100 MHz		90	_____	-	dB	
FSU 8:						
3700 MHz		70	_____	-	dB	
5000 MHz		70	_____	-	dB	
7999 MHz		70	_____	-	dB	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
Image frequency rejection 3rd IF, f_{in}	Page 1.4					
FSU 3 / 8:						
100 MHz		90	_____	-	dB	
FSU 8:						
4500 MHz		70	_____	-	dB	
1st IF rejection f_{in}	Page 1.5					
11 MHz		90	_____	-	dB	
100 MHz		90	_____	-	dB	
1701 MHz		90	_____	-	dB	
2990 MHz		90	_____	-	dB	
2^{nd} IF rejection f_{in}	Page 1.5					
FSU 3 / 8:						
100 MHz		90	_____	-	DB	
FSU 3 / 8:						
4500 MHz		70	_____	-	dB	
3rd-order intercept point, f_{in}	Page 1.6					
FSU 3 / 8:						
28 MHz		17	_____	-	dBm	
106 MHz		17	_____	-	dBm	
261 MHz		17	_____	-	dBm	
640 MHz		20	_____	-	dBm	
1000 MHz		20	_____	-	dBm	
1700 MHz		20	_____	-	dBm	
2500 MHz		20	_____	-	dBm	
3590 MHz		20	_____	-	dBm	
FSU 8 :						
4001 MHz		18	_____	-	dBm	
5001 MHz		18	_____	-	dBm	
7999 MHz		18	_____	-	dBm	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
2nd-order harmonic distortion, f_{in} :	Page 1.7					
FSU 3 / 8:						
28 MHz		35	_____	-	dBm	
106 MHz		35	_____	-	dBm	
261 MHz		45	_____	-	dBm	
640 MHz		45	_____	-	dBm	
1000 MHz		45	_____	-	dBm	
1700 MHz		35	_____	-	dBm	
IF bandwidth switch. level accuracy	Page 1.8					
100 Hz		-0.1	_____	+0.1	dB	
1 kHz		-0.1	_____	+0.1	dB	
10 kHz		-	reference	-		
100 kHz		-0.1	_____	+0.1	dB	
300 kHz		-0.2	_____	+0.2	dB	
1 MHz		-0.2	_____	+0.2	dB	
3 MHz		-0.2	_____	+0.2	dB	
10 MHz		-0.2	_____	+0.2	dB	
20 MHz		-0.5	_____	+0.5	dB	
FFT Bandwidth level accuracy	Page 1.8					
100 Hz		-0.2	_____	+0.2	dB	
300 Hz		-0.2	_____	+0.2	dB	
1 kHz		-0.2	_____	+0.2	dB	
3 kHz		-0.2	_____	+0.2	dB	
IF bandwidth Bandwidth:	Page 1.9					
100 Hz		97	_____	103	Hz	
1 kHz		970	_____	1030	Hz	
10 kHz		9.7	_____	10.3	kHz	
100 kHz		97	_____	103	kHz	
300 kHz		270	_____	330	kHz	
1 MHz		900	_____	1100	kHz	
3 MHz		2.7	_____	3.3	MHz	
10 MHz		7	_____	11	MHz	
20 MHz		14	_____	22	MHz	
50 MHz		35	_____	55	MHz	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
IF Bandwidths Shape factor:	Page 1.9					
100 Hz		-	_____	6	-	
1 kHz		-	_____	6	-	
10 kHz		-	_____	6	-	
100 kHz		-	_____	6	-	
300 kHz		-	_____	12	-	
1 MHz		-	_____	12	-	
3 MHz		-	_____	12	-	
10 MHz		-	_____	7	-	
Noise Display f_{noise}:	Page 1.10					
20 Hz		-	_____	-80	dBm	
90 Hz		-	_____	-100	dBm	
900 Hz		-	_____	-110	dBm	
Noise Display **FSU 3 / 8:** f_{noise} normalized to 10Hz:	Page 1.10					
9 kHz		-	_____	-120	dBm	
95 kHz		-	_____	-120	dBm	
999 kHz		-	_____	-130	dBm	
9.99 MHz		-	_____	-145	dBm	
19.99 MHz		-	_____	-145	dBm	
49.99 MHz		-	_____	-145	dBm	
99.99 MHz		-	_____	-145	dBm	
199.9 MHz		-	_____	-145	dBm	
499.9 MHz		-	_____	-145	dBm	
999.9 MHz		-	_____	-145	dBm	
1499 MHz		-	_____	-145	dBm	
1999 MHz		-	_____	-145	dBm	
2499 MHz		-	_____	-143	dBm	
2999 MHz		-	_____	-143	dBm	
3599 MHz		-	_____	-142	dBm	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
Noise Display	Page 1.10					
FSU 8: f_{noise}: normalized to 10Hz:						
3999 MHz		-	_____	-142	dBm	
4499 MHz		-	_____	-142	dBm	
4999 MHz		-	_____	-142	dBm	
5499 MHz		-	_____	-142	dBm	
5999 MHz		-	_____	-142	dBm	
6499 MHz		-	_____	-142	dBm	
6999 MHz		-	_____	-142	dBm	
7499 MHz		-	_____	-142	dBm	
7999 MHz		-	_____	-142	dBm	
Level accuracy	Page 1.11					
at 128 MHz. -30dBm		-0.2	_____	+0.2	dB	
Frequency response	Page 1.11					
RF Attenuation 10 dB						
DC coupling						
FSU 3 / 8: f_{fresp}						
1 MHz		-0.5	_____	+0.5	dB	
10 MHz		-0.3	_____	+0.3	dB	
50 MHz		-0.3	_____	+0.3	dB	
100 MHz		-0.3	_____	+0.3	dB	
200 MHz		-0.3	_____	+0.3	dB	
300 MHz		-0.3	_____	+0.3	dB	
400 MHz		-0.3	_____	+0.3	dB	
500 MHz		-0.3	_____	+0.3	dB	
600 MHz		-0.3	_____	+0.3	dB	
700 MHz		-0.3	_____	+0.3	dB	
800 MHz		-0.3	_____	+0.3	dB	
900 MHz		-0.3	_____	+0.3	dB	
1000 MHz		-0.3	_____	+0.3	dB	
1500 MHz		-0.3	_____	+0.3	dB	
2000 MHz		-0.3	_____	+0.3	dB	
2500 MHz		-0.3	_____	+0.3	dB	
3000 MHz		-0.3	_____	+0.3	dB	
3599 MHz		-0.3	_____	+0.3	dB	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
Frequency response RF Attenuation 10 dB DC coupling **FSU 8:** f_{fresp}	Page 1.11					
3610 MHz		-2	_____	+2	dB	
4000 MHz		-2	_____	+2	dB	
4500 MHz		-2	_____	+2	dB	
5000 MHz		-2	_____	+2	dB	
5500 MHz		-2	_____	+2	dB	
6000 MHz		-2	_____	+2	dB	
6500 MHz		-2	_____	+2	dB	
6990 MHz		-2	_____	+2	dB	
7990 MHz		-2	_____	+2	dB	
Frequency response RF Attenuation 10 dB AC coupling f_{fresp}	Page 1.11					
10 MHz		-0.3	_____	+0.3	dB	
50 MHz		-0.3	_____	+0.3	dB	
100 MHz		-0.3	_____	+0.3	dB	
200 MHz		-0.3	_____	+0.3	dB	
500 MHz		-0.3	_____	+0.3	dB	
1000 MHz		-0.3	_____	+0.3	dB	
1500 MHz		-0.3	_____	+0.3	dB	
2000 MHz		-0.3	_____	+0.3	dB	
2500 MHz		-0.3	_____	+0.3	dB	
3000 MHz		-0.3	_____	+0.3	dB	
3599 MHz		-0.3	_____	+0.3	dB	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
Frequency response RF Attenuation 5 dB DC coupling f_{fresp}	Page 1.11					
10 MHz		-0.3	_____	+0.3	dB	
50 MHz		-0.3	_____	+0.3	dB	
100 MHz		-0.3	_____	+0.3	dB	
200 MHz		-0.3	_____	+0.3	dB	
500 MHz		-0.3	_____	+0.3	dB	
1000 MHz		-0.3	_____	+0.3	dB	
1500 MHz		-0.3	_____	+0.3	dB	
2000 MHz		-0.3	_____	+0.3	dB	
2500 MHz		-0.3	_____	+0.3	dB	
3000 MHz		-0.3	_____	+0.3	dB	
3599 MHz		-0.3	_____	+0.3	dB	
Frequency response RF Attenuation 20 dB DC coupling f_{fresp}	Page 1.11					
10 MHz		-0.3	_____	+0.3	dB	
50 MHz		-0.3	_____	+0.3	dB	
100 MHz		-0.3	_____	+0.3	dB	
200 MHz		-0.3	_____	+0.3	dB	
500 MHz		-0.3	_____	+0.3	dB	
1000 MHz		-0.3	_____	+0.3	dB	
1500 MHz		-0.3	_____	+0.3	dB	
2000 MHz		-0.3	_____	+0.3	dB	
2500 MHz		-0.3	_____	+0.3	dB	
3000 MHz		-0.3	_____	+0.3	dB	
3599 MHz		-0.3	_____	+0.3	dB	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
Frequency response RF Attenuation 40 dB DC coupling f_{fresp}	Page 1.11					
10 MHz		-0.3	_____	+0.3	dB	
50 MHz		-0.3	_____	+0.3	dB	
100 MHz		-0.3	_____	+0.3	dB	
200 MHz		-0.3	_____	+0.3	dB	
500 MHz		-0.3	_____	+0.3	dB	
1000 MHz		-0.3	_____	+0.3	dB	
1500 MHz		-0.3	_____	+0.3	dB	
2000 MHz		-0.3	_____	+0.3	dB	
2500 MHz		-0.3	_____	+0.3	dB	
3000 MHz		-0.3	_____	+0.3	dB	
3599 MHz		-0.3	_____	+0.3	dB	
Display linearity RBW 500 Hz a_{ATT} :	Page 1.14					
10 dB		9.9	_____	10.1	dB	
15 dB		4.9	_____	5.1	dB	
20 dB		-	Referenz	-	-	
25 dB		-5.1	_____	-4.9	dB	
30 dB		- 10.1	_____	-9.9	dB	
35 dB		-15.1	_____	-14.9	dB	
40 dB		-20.1	_____	-19.9	dB	
45 dB		-25.1	_____	-24.9	dB	
50 dB		-30.1	_____	-29.9	dB	
55 dB		-35.1	_____	-34.9	dB	
60 dB		-40.1	_____	-39.9	dB	
65 dB		-45.1	_____	-44.9	dB	
70 dB		-50.1	_____	-49.9	dB	
75 dB		-55.1	_____	-54.9	dB	
80 dB		-60.1	_____	-59.9	dB	
85 dB		-65.3	_____	-64.7	dB	
90 dB		-70.3	_____	-69.7	dB	
95 dB		-75.3	_____	-74.7	dB	
100 dB		-80.3	_____	-79.7	dB	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
Display linearity RBW 300 kHz a_{ATT} :	Page 1.14					
10 dB		9.8	_____	10.2	dB	
15 dB		4.8	_____	5.2	dB	
20 dB		-	Referenz	-	-	
25 dB		-5.2	_____	-4.8	dB	
30 dB		- 10.2	_____	-9.8	dB	
35 dB		-15.2	_____	-14.8	dB	
40 dB		-20.2	_____	-19.8	dB	
45 dB		-25.2	_____	-24.8	dB	
50 dB		-30.2	_____	-29.8	dB	
55 dB		-35.2	_____	-34.8	dB	
60 dB		-40.2	_____	-39.8	dB	
65 dB		-45.5	_____	-44.5	dB	
70 dB		-50.5	_____	-49.5	dB	
75 dB		-55.5	_____	-54.5	dB	
80 dB		-60.5	_____	-59.5	dB	
Display linearity RBW 20 MHz a_{ATT} :	Page 1.14					
10 dB		9.5	_____	10.5	dB	
15 dB		4.5	_____	5.5	dB	
20 dB		-	Referenz	-	-	
25 dB		-5.5	_____	-4.5	dB	
30 dB		– 10.5	_____	-9.5	dB	
35 dB		-15.5	_____	-14.5	dB	
40 dB		-20.5	_____	-19.5	dB	
45 dB		-25.5	_____	-24.5	dB	
50 dB		-30.5	_____	-29.5	dB	
55 dB		-35.5	_____	-34.5	dB	
60 dB		-40.5	_____	-39.5	dB	
65 dB		-45.5	_____	-44.5	dB	
70 dB		-50.5	_____	-49.5	dB	
Attenuator accuracy a_{ATT} :	Page 1.15					
0 dB		-9.8	_____	-10.2	dB	
5 dB		-4.8	_____	-5.2	dB	
10 dB		-	reference	-	-	
20 dB		+9.8	_____	+10.2	dB	
40 dB		+29.8	_____	+30.2	dB	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
Reference level switching accuracy	Page 1.16					
Reference level						
0 dBm		+9,85	_____	+10,15	dB	
-10 dBm		-	reference	-	-	
-20 dBm		-10.15	_____	-9,85	dB	
-30 dBm		-20.15	_____	-19,85	dB	
-40 dBm		-30.15	_____	-29,85	dB	
-50 dBm		-40.15	_____	-39,85	dB	
-11 dBm		-1.15	_____	-0,85	dB	
-12 dBm		-2.15	_____	-1,85	dB	
-13 dBm		-3.15	_____	-2,85	dB	
-14 dBm		-4.15	_____	-3,85	dB	
-15 dBm		-5.15	_____	-4,85	dB	
-16 dBm		-6.15	_____	-5,85	dB	
-17 dBm		-7.15	_____	-6,85	dB	
-18 dBm		-8.15	_____	-7,85	dB	
-19 dBm		-9.15	_____	-8,85	dB	
Phase noise	Page 1.18					
Offset frequency:						
100 Hz		-	_____	-90	dBc (1Hz)	
1 kHz		-	_____	-112	dBc (1Hz)	
10 kHz		-	_____	-120	dBc (1Hz)	
100 kHz		-	_____	-120	dBc (1Hz)	
1 MHz		-	_____	-138	dBc (1Hz)	

Characteristic	Included in	Min. value	Actual value	Max. value	Unit	Tolerance
Return Loss	Page 1.20					
RF input						
RF Att 10 dB / DC						
f_{in}						
FSU 3 / FSU 8:						
10 MHz		14	_____	-	dB	
250 MHz		14	_____	-	dB	
500 MHz		14	_____	-	dB	
750 MHz		14	_____	-	dB	
1000 MHz		14	_____	-	dB	
1250 MHz		14	_____	-	dB	
1500 MHz		14	_____	-	dB	
1750 MHz		14	_____	-	dB	
2000 MHz		14	_____	-	dB	
2250 MHz		14	_____	-	dB	
2500 MHz		14	_____	-	dB	
2750 MHz		14	_____	-	dB	
3000 MHz		14	_____	-	dB	
3250 MHz		14	_____	-	dB	
3500 MHz		14	_____	-	dB	
FSU 8:						
3750 MHz		9,5	_____	-	dB	
4000 MHz		9,5	_____	-	dB	
4250 MHz		9,5	_____	-	dB	
4500 MHz		9,5	_____	-	dB	
4750 MHz		9,5	_____	-	dB	
5000 MHz		9,5	_____	-	dB	
5500 MHz		9,5	_____	-	dB	
6000 MHz		9,5	_____	-	dB	
6500 MHz		9,5	_____	-	dB	
7000 MHz		9,5	_____	-	dB	

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2 Adjustment

The following chapter describes the adjustment of the reference sources as well as the software-controlled adjustment of individual module data following module replacement.

The FSU permits the following manual adjustments:

- Adjustment of the 10 MHz reference oscillator which determines the frequency accuracy of the FSU
- Adjustment of the 128 MHz calibration source which determines the level accuracy of the FSU

The adjustment permits to maintain and restore the data integrity of the instrument.

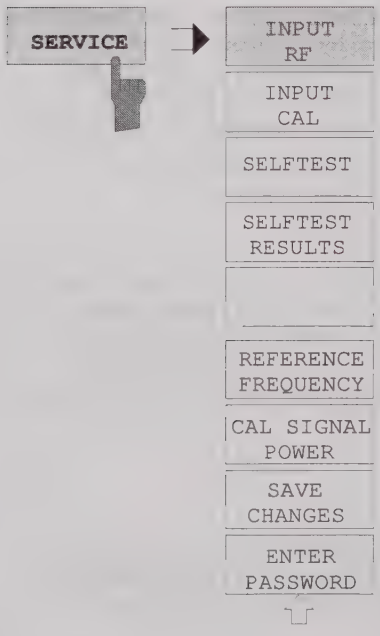
Manual adjustments must be performed at an ambient temperature between +20 °C and +30 °C after the instrument has warmed up.

After the adjustment and an internal total calibration has been performed, the FSU is ready for use and offers full data integrity.

Service Menu

The service functions for adjusting the boards are only useable after the entry of a password to prevent impairment of instrument functionality by unintended data changes.

SETUP menu:



The *SERVICE* softkey opens a submenu for selection of the service function

Entering the Password

SETUP SERVICE submenu:

The *ENTER PASSWORD* softkey allows the entry of a password.

The FSU contains a variety of service functions which, if incorrectly used, can impair the functionality of the analyzer. These functions are normally not accessible and are only usable after the entry of a password.

The password permits change of data which must be modified for calibration or repair of the instrument (for example reference frequency adjustment, level adjustment, general board data). The password is "894129".

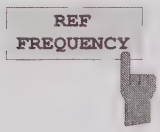
IEC/IEEE-bus command: `SYST:PASS "<Password>"`

Adjustment Functions

Caution:

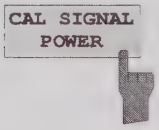
The re-alignment should be carried out by qualified personnel since any change considerably influences the measurement accuracy of the instrument. This is the reason why the softkeys REF FREQUENCY, CAL SIGNAL POWER and SAVE CHANGES can only be accessed after entering a password.

SETUP SERVICE submenu:



The *REF FREQUENCY* softkey opens the data input for the adjustment of the reference frequency. Values can be selected between 0 and 255 (without option FSU-B4 OCXO) or between 0 to 4095 (with option FSU-B4 OXCO). They modify the setting of the associated D/A converter. The setting is first stored in the volatile memory. The *SAVE CHANGES* softkey is used to store it permanently in the nonvolatile memory.

IEC/IEEE-bus command: `SENS:ROSC:INT:TUN 155`



The *CAL SIGNAL POWER* softkey opens the data input for the adjustment of the currently set level of the calibration signal (0 dBm or -30 dBm, compare *INPUT CAL* softkey). Values can be selected between 0 and 255. They modify the setting of the associated D/A converter. The setting is first stored in the volatile memory. The *SAVE CHANGES* softkey is used to store it permanently in the nonvolatile memory.

IEC/IEEE-bus command: --

The *SAVE CHANGES* softkey stores the modifications in the nonvolatile memory of the instrument. Since these modifications considerably influence the measurement accuracy of the instrument, confirmation by the user is requested before storing.

IEC/IEEE-bus command: `SENS:ROSC:INT:TUN:SAV`

Manual Adjustment

In the following, the measuring instruments and auxiliary means required for the manual adjustment of the FSU, the appropriate preparations of the instrument as well as the individual adjustments will be explained.

Test Instructions

- The adjustment of the analyzer must be done after a warm-up time of at least 30 minutes and overall calibration. Only in this case can the compliance with the guaranteed data be ensured.
- Inputs for setting the FSU during measurements are shown as following:

  [**<KEY>**] Press a key on the front panel, eg **[SPAN]**

  [<SOFTKEY>] Press a softkey, eg [MARKER -> PEAK]

  [<**nn unit**>] Enter a value and terminate by entering the unit, eg [**12 kHz**]

  Successive entries are separated by [:], eg. [**BW** : RES BW MANUAL : **3 kHz**]

Measuring Equipment and Accessories

Table 2-1 Measuring Equipment and Accessories for manual adjustment of the FSU

Item	Type of equipment	Specifications recommended	Equipment recommended	R&S Order No.	Use
1	Frequency counter	error < $1x10^{-9}$, frequency range up to 10 MHz	Advantest R5361B with option 23		Frequency Accuracy of Reference Oscillator
2	Signal generator	frequency range to 1 GHz: output level -10 dBm	SMHU	0835.8011.52	Calibration Source 128 MHz Frequency Accuracy of Reference Oscillator
3	Power meter		NRVD	0857.8008.02	Calibration Source 128 MHz
4	Power sensor	1 MHz to 3.6 GHz RSS ≤ 0.8% Meter noise ≤ 20 pW	NRV-Z4	0828.3618.02	Calibration Source 128 MHz

Adjusting the level measurement accuracy

Test equipment:

- Signal generator (Section "Measurement Equipment", item 2):
  frequency 128 MHz
  level -30 dBm
- power meter (Section "Measurement Equipment", item 3)
- power sensor (Section "Measurement Equipment", item 4)
  frequency 128 MHz
  maximum power $P_{max} \geq 1$ µW
  meter noise ≤ 20 pW
  RSS ≤ 0.8% referred to indicated power
  impedance Z = 50 Ω

Power meter settings:

➢ connect power sensor to power meter and carry out function ´ZERO´ when no signal is applied to the power sensor.

➢ connect power sensor to RF output of signal generator.

Signal generator settings:

- frequency 128 MHz
- level –30 dBm ± 0.05 dB

➢ use power meter for exact level adjustment.

Test setup:

➢ connect RF output of the signal generator to RF input of the FSU

Overall calibration of FSU:

- [**PRESET**]
- [**CAL** : CAL TOTAL]

FSU settings:

- [**FREQ** : CENTER : **128 MHz**]
- [**SPAN** : **15 kHz**]
- [**BW** : RES BW MANUAL : **10 kHz**]
- [**BW** : VID BW MANUAL : **1 kHz**]
- [**TRACE** : DETEKTOR : RMS]
- [**AMPT** : REF LEVEL : **-20 dBm**]
- [**AMPT** : RF ATTEN MANUAL : **10 dB**]

Reference measurement

➢ set marker to peak of signal
- [**MKR SEARCH** : PEAK]

➢ set reference to peak of signal
- - [**MKR** : REFERENCE FIXED]

➢ switch internal reference generator to RF input
- [**SETUP** : SERVICE : INPUT CAL]

➢ set marker to peak of signal
- [**MKR** ⇒ : PEAK]

Adjustment:

The reading ´Delta [T1 FXD]´ displays the difference between the output level of the signal generator and the level of the calibration source.

Caution:

The following re-alignment changes the level of the internal calibration source. Since this adjustment influences the level measurement accuracy of the FSU, it is strongly recommended to perform this adjustment only if the level is not within the tolerance. .

FSU settings:

- [**SETUP :** SERVICE : ENTER PASSWORD : **894129 ENTER**]
- [**SETUP :** SERVICE : CAL SIGNAL POWER]

➢ The correction value for the calibration signal level will be displayed in the data entry field. Change the value with the step keys or spin wheel until the marker reading ´Delta [T1 FXD]´ displays a value of 0 ± 0,05 dB.

Store value in instrument

- [**SETUP :** SERVICE : SAVE CHANGES]

➢ Confirm message on display with ´YES´ . The correction values will be stored in the non volatile memory of the boards.

Note:

The changed level of the calibration source will be used with the following total calibration.

- [**CAL :** TOTAL CALIBRATION]
- [**CAL :** CALIBRATION RESULTS]

➢ Check the calibration results. The calibration must be performed with the status ´PASSED`.

Adjusting the frequency accuracy

Preparation: The measurement can be performed either with a signal generator at connector RF INPUT (front of FSU) at 1 GHz or at connector EXT REF OUT (rear of FSU) at 10 MHz using a frequency counter
For the adjustment, the FSU must be set to internal reference.

Note: *The measurement at 1 GHz can be performed with a lower frequency counter resolution in order to achieve a faster adjustment.*

Preparations for adjustment with signal generator:

Test equipment:
- Signal generator (Section "Measurement Equipment", item 2):
  frequency 1000 MHz
  level -20 dBm
  frequency accuracy $<1x10^{-9}$

If the frequency accuracy of the signal generator is not sufficient, adjust the frequency with a frequency counter to the correct frequency before the adjustment.

Test setup:
➢ connect RF output of the signal generator to RF input of the FSU

FSU settings:
- [**PRESET**]
- [**FREQ** : CENTER : **1 GHz**]
- [**SPAN** : **0 Hz**]
- [**BW** : RES BW MANUAL : **30 kHz**]
- [**AMPT** : REF LEVEL : **-20 dBm**]
- [**AMPT** : RF ATTEN MANUAL : **10 dB**]
- [**SETUP** : REFERENCE INT / EXT]

➢ toggle to internal reference (INT)

Note: *Before the following measurement, the FSU must warm up for at least 30 minutes to heat the reference oscillator.*

Measurement:

➢ switch on marker frequency counting:
- [**MKR** : SIGNAL COUNT]

➢ Set the necessary resolution:
Model without OCXO (Option B4) 1 GHz ± 100 Hz
- [**MKR** : **NEXT** : CNT RESOL 10 HZ]

Model with OCXO (Option B4) 1 GHz ± 30 Hz
- [**MKR** : **NEXT**: CNT RESOL 1 HZ]

Preparation for adjustment with frequency counter:

Test equipment:

Frequency counter (Section "Measurement Equipment", item 1):
error < $1x10^{-9}$
frequency range up to 10 MHz

Test setup:

➢ connect frequency counter to 10-MHz reference output of the FSU (rear panel)

FSU settings:

- [**SETUP** : REFERENCE INT / EXT]
➢ toggle to internal reference (INT)

frequency counter settings:

➢ Set the necessary resolution:
model without OCXO (option FSU-B4): 1 Hz
model with OCXO (option FSU-B4): 0.1 Hz

Note:

Before the following measurement, the FSU must warm up at least 30 minutes to heat the reference oszillator.

Measurement:

➢ measure frequency with frequency counter:

nominal frequency:
model without OCXO (option FSU-B4) ..... 10 MHz ± 1 Hz
model with OCXO (option FSU-B4) ..... 10 MHz ± 0.3 Hz

Adjustment:

Important Note !

The following adjustment changes the frequency of the internal reference source. Since this adjustment influences the frequency accuracy of the FSU, it is strongly recommended to perform this adjustment only if the frequency is not within the tolerance.

FSU settings:

- [**SETUP :** SERVICE : ENTER PASSWORD : **894129 ENTER**]
- [**SETUP :** SERVICE : REF FREQUENCY]

➢ The correction value for the reference frequency adjust will be displayed in the data entry field. Change the value with the step keys or spin wheel until the frequency counter reading or the marker count reading displays a value within the tolerance.

Store value in instrument

- [**SETUP :** SERVICE : SAVE CHANGES]

➢ Confirm message on display with ´YES´ . The correction values will be stored in the non volatile memory of the boards.

Adjustment of Module Data

All boards of the FSU contain EEPROMS for storage of board data.
In addition to some standard information such as module name, serial number, hardware status and date of manufacture, these stored data items contain important pieces of information within value tables from module pre-testing, e.g. frequency responses for module error data.

In order to match the data stored in EEPROMs on the respective modules to the complete instrument, an adjustment of module data is always performed automatically after replacing a module:

The module header is read from the EEPROMs and compared to the contents of the associated binary file stored on the hard disk. If the header coincides with the data from the binary file it is assumed that the binary file is an exactly mapping EERPOM and the contents of the binary file is loaded in the RAM.
After replacing a module, these data usually do no longer coincide. The FSU then detects a board replacement and starts the automatic board adjustment. The complete contents of the new module are read from the EERPOM and copied to the hard disk of the FSU. The existing calibration data (results from the latest total calibration) are deleted and the instruments displays UNCAL. Thus, the FSU must always be calibrated again after replacement of a module (Softkey *CAL TOTAL*).

Frequency response correction

With some boards (see chapter 3, section "Module Exchange") an frequency response correction is necessary in addition to the automatic adjustment of module data. This correction is performed by means of a software.
For information when to on perform the frequency response correction see chapter 3, section "Module Replacement".

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3 Repair

This chapter describes the design of the FSU, simple measures for repair and troubleshooting and, in particular, the replacement of modules. For troubleshooting and diagnosis, a selftest is available, which permits to poll diagnostic voltages of the modules and indicate limit violations.

The firmware update and the installation of options are described in chapter 4 in this service manual.

Instrument Design and Function Description

A detailed schematic of the FSU design will be presented in the block diagrams below and in the attachments (see also chapter 5).
The following function description of the instrument refers to the block diagram.

Block diagram

see also chapter 5, drawings, for a detailed block circuit.

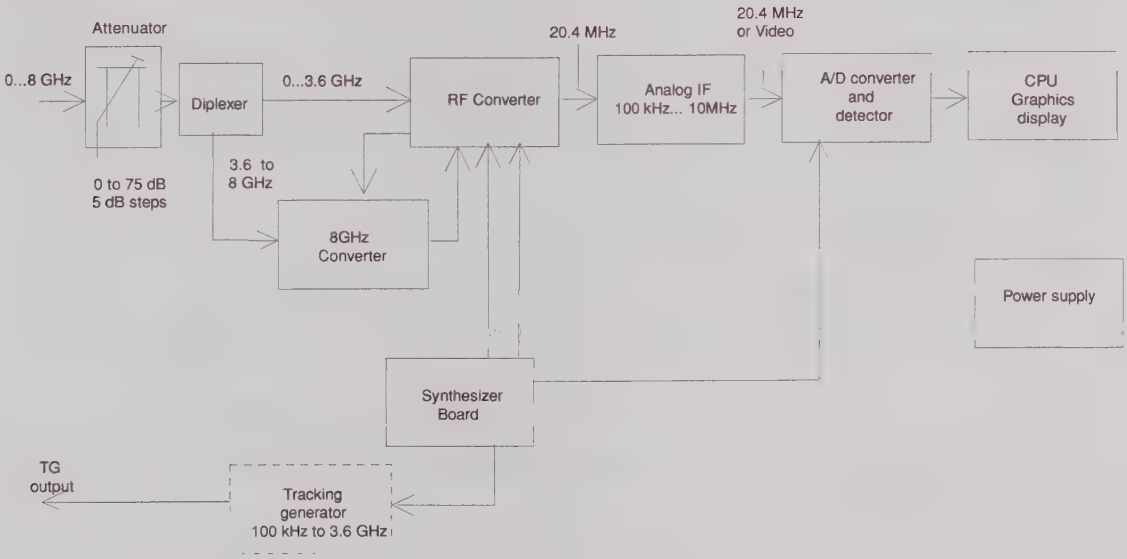


Fig. 3-1 Block diagramm

Description of Block diagram

The FSU is a triple-conversion superhet receiver (double-conversion for receive frequencies >3.6 GHz) for the frequency range 20 Hz to several GHz, depending on the instrument model. The signals are processed by one RF board (two for models > 3.6 GHz), one IF board, one signal detection board and a controller comprising a Pentium industry PC, an I/O interface and a graphic controller. The instrument can be upgraded to meet future requirements by retrofitting options in the analog and digital sections.

The input signal is reduced in level by the attenuator and routed to the RF modules depending on the instrument type. In instruments with option B25 (electronic attenuator), this module follows in the signal path. In 3.6 GHz-Models the attenuator is followed by the RF-Converter directly, in the high-frequency models a diplexer is connected in between. The high-frequency signal component >3.6 GHz is routed to the microwave converter module following the diplexer. The IF module is the same in all instrument models, likewise the signal path through signal detection to the display.

The internal reference and calibration signals are generated in the frequency and level reference part on the synthesizer board. Here the 128 MHz reference frequency is generated and made available to the instrument as a reference frequency, and a level-controlled output signal is generated as an internal level reference for instrument calibration.

A detailed description of the modules is given in the following.

Attenuator

The RF signal passes from the input connector via the input switch to the input attenuator, which can be set from 0 to 75 dB in steps of 5 dB. The input signal is applied to the switch as well as a 128 MHz signal which has a close-tolerance level of -30 dBm for calibration purposes or 0 dBm for the selftest of the instrument. AC coupling can be set via an additional switch, the lower cut off frequency is app. 1 MHz.

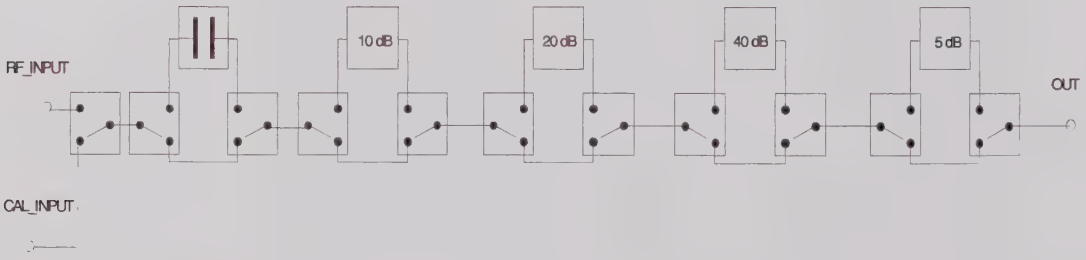


Fig. 3-2 RF Attenuator

Electronic Attenuator (Option FSU-B25)

The Electronic attenuator is fitted in the RF signal pass directly behind the input attenuator. It consists of different parts: an electronic attenuator, which can be switched from 0 to 30 dB in steps of 5 dB and an switchable preamplifier to reduce the noise figure of the instrument.

RF to IF Conversion for Frequencies < 3.6 GHz – Frontend

FSU-3 uses the RF converter for conversion to the 20.4 MHz IF. There is a symmetrical input mixer on this board which converts the input signal to an intermediate frequency of app. 4.63 GHz. The symmetric design reduces second order intermodulation .
The local oscillator in the frequency range 4.63 to 8.23 GHz is generated with a YIG tuned oscillator. This oscillator is synchronized via several dividers to the signal from the synthesizer module (600 to 620 MHz). The output of the first mixer is amplified with two bipolar transistors to avoid 1/f noise. This balanced signal is feed to a three stage filter with dielectric resonators. Flatness and group delay of the filter are optimized for broadband vector analyses in a bandwidth of 30 MHz. The filter feeds a second mixer, which converts the signal to the second IF of 404.4 MHz. The symmetric output is amplified with two amplifiers to reduce intermodulation products. The signal from the two amplifiers are combined in a transformer to an unbalanced signal. The symmetric design reduces the need of transformers in the mixers and therefore reduces the conversion loss.
The 404.4 MHz signal can be filtered to a bandwidth of 10 or 20 MHz with two filters with five stages each. A bypass for a 50 MHz bandwidth (= 3dB bandwidth of the first IF Filter) can be selected also. The signal is feed to a 31 dB step attenuator (1dB resolution) which reduces the signal level in the case of broadband FFT mode. With 30 MHz FFT span the K2 of the 3rd mixer causes spurious within the band. Therefore the level has to be reduced before this mixer stage if high input levels are used (> -25dBm) . The attenuator can be used also to take reference values of up to +5 dBm mixer level in phasenoise or spurious measurements with very high dynamic range.
Fast overload detectors are used with directional couplers to detect compression in the stages of the first and second intermediate frequency. The bandwidth of this detectors is above 100 MHz, therefore pulse signals can be detected correctly with a 100 MHz wide preselector. The output signal of the detector on the first IF is also used with a fast logarithmic amplifier as a RF power trigger with about 60 dB dynamic range.

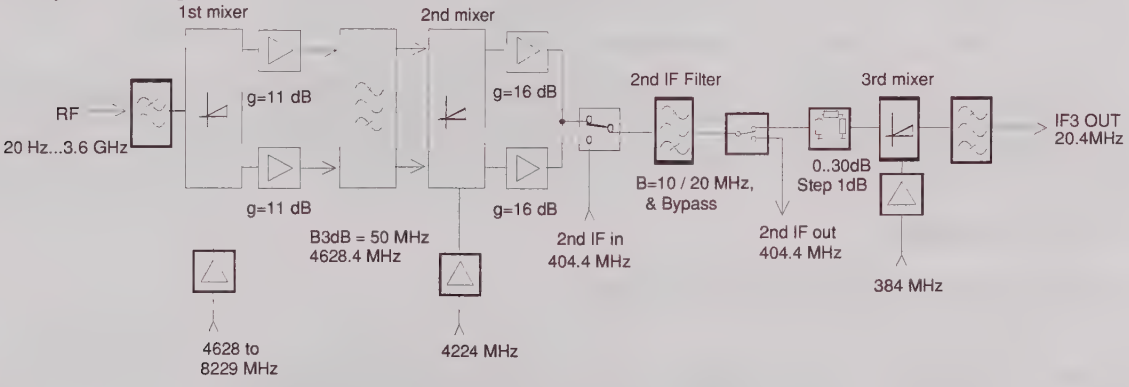


Fig. 3-3 RF to IF Conversion for Frequencies < 3.6 GHz

RF to IF Conversion for Frequencies > 3.6 GHz - MW Converter

The high frequency models of FSU (frequency range > 3.6 GHz) also comprise a microwave converter board. From the attenuator output the input signals are feed to the microwave converter and split up in the diplexer to frequencies below 3.6 GHz and above 3.6 GHz. Signals below 3.6 GHz are forwarded to the RF converter like in the FSU 3. Signals in the range higher than 3.6 GHz are feed to the mixer via the YIG filter for an intermediate frequency of 404.4 MHz. This output is connected to the RF converter, where it is filtered and down converted to 20.4 MHz.

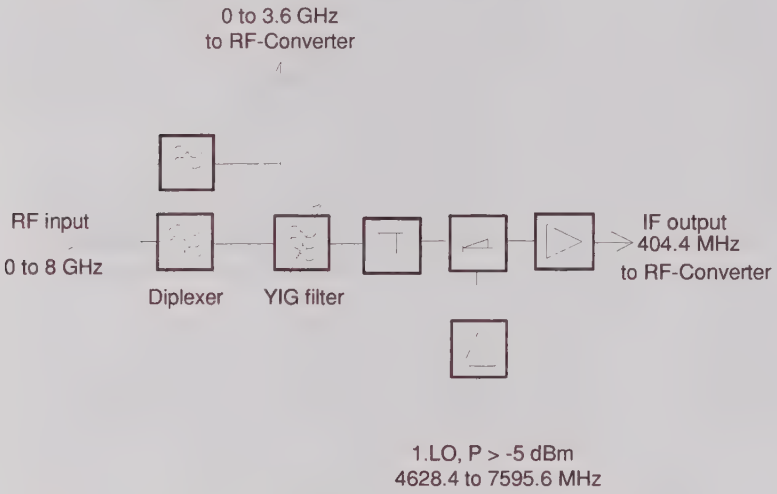


Fig. 3-4 RF to IF Conversion for Frequencies > 3.6 GHz

The first LO converts the input frequency directly to the 404.4 MHz IF. For this purpose the LO signal (4 to 7.6 GHz) generated in the RF-converter is amplified to the required LO level.
The basic model is equipped with the necessary interfaces (IF input 404.4 MHz, LO output 4 to 7.6 GHz) for extending the frequency range by simply adding a microwave converter.

IF Filter – Module

The RF converter is followed by the IF filter module :

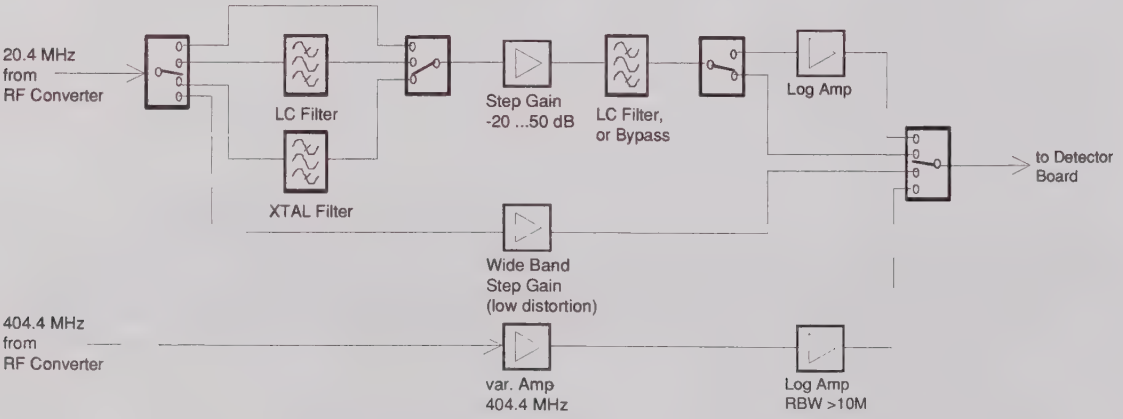


Fig. 3-5 IF Filter

FSU offers resolution bandwidths from 1 Hz to 20 MHz in steps of 1/2/3/5 and 50 MHz. The selection filter at the 2nd IF of 404.4 MHz in the RF converter yields the 10, 20 and 50 MHz bandwidth.

The tunable bandwidths 200 kHz to 5 MHz are at the 3rd IF (20.4 MHz) on the IF filter module. The bandwidths 100 kHz to 5 MHz are provided by 5 LC circuits. Two stages are in front of the step gain amplifier and three are after this amplifier due to a compromise between good noise figure and overrange protection of the step gain amplifier.
The step gain can be set from -20 to 50 dB in 0.1 dB steps and is adjusted as a function of the reference level and the input attenuation.
The LC filters are followed by a log detector to obtain the display dynamic range.
The module also comprises a limiting amplifier (in the log-amp) with a TTL output for the frequency counter.
With 10 MHz of resolution bandwidth the LC filters are bypassed, the log amp is used in the same manner than with bandwidth between 200 kHz and 10 MHz.

For the digital resolution filters from 1 Hz to 100 kHz, the 20.4 MHz IF signal at the IF filter output is routed to the A/D converter. With bandwidth below or equal 30 kHz a crystal filter in front of the step gain is used to avoid over-steering of the step gain and the ADC. This filter can be tuned from about 2.5 to 70 kHz in bandwidth. With bandwidth 50 kHz and 100 kHz the two LC filters in front of the step gain are set to about 300 kHz for the same reason.

An additional path without any filtering is used for the broadband vector analyses. The variable gain amplifier is optimized for low distortion, as with a bandwidth of 30 MHz at 20.4 MHz center frequency the harmonics of the IF are also present at the input of the ADC.

OCXO Reference (Option FSU-B4)

The FSU contains as an option FSU-B4 an oven controlled reference oscillator. This OCXO generates a 10 MHz signal which is routed to the IF-Filter board and used as reference signal.

Processing of Measured Data - Detector Board

The chapters below explain the signal and data paths required for result processing in the various operating modes:

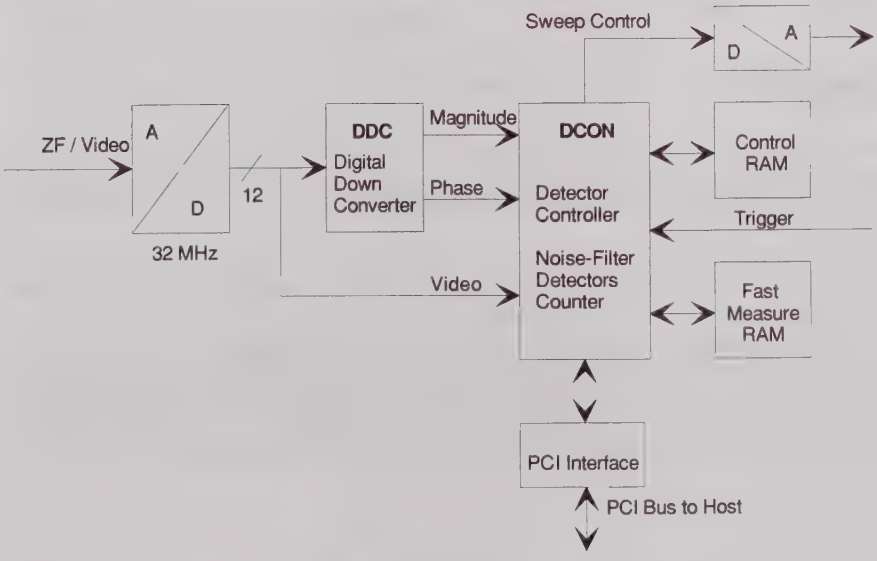


Fig. 3-6 Processing of measured data

Spectrum Analysis Using an RBW >100 kHz

In this mode only the analog resolution filters on the IF filter board are used. The signal applied to the A/D converter via the input IF/Video is therefore already a log video signal. The signal is continuously sampled at 32 MHz in the ADC and digitized.
The signal path is now directly routed to DCON.
In the DCON, the data are directly applied to the noise filter. The noise filter serves for limiting the video bandwidth or for averaging the noise content. The signal path is routed to the detector logic where the results are processed, ie peak max, peak min, sample, average and RMS values as well as the number of measured values and quasi-peak values are determined.
With measurement data rates > 1 MHz, detector data have to be stored in the measurement RAM because online processing is no longer possible at these high speeds. Upon completion of the sweep, the sweep data are read by the host from the measurement RAM, processed and displayed.

Spectrum Analysis Using an RBW ≤ 100 kHz

In this operating mode the resolution bandwidths are generated digital with the aid of the DDC (digital down converter). This IC converts the input signal into the baseband using an NCO (numeric controlled oscillator), and then filters the obtained I/Q signal via a HDF (**h**igh **d**ecimation **f**ilter) and a FIR (**f**inite **i**mpulse **r**esponse) filter stage. At the end of the DDC processing chain, the I/Q signal in the CORDIC block is split up in magnitude and phase. For signal processing in the DDC, the IF signal from the IF filter module directly represents the linear IF.
Further signal processing on the detector board is identical to that of operating mode RBW > 100 kHz.

FFT bandwidth

In FFT bandwith mode, the synthesizer is set to the desired frequency via the DCON which also generates the tuning voltages for the analog hardware. The signal path is routed via ADC, Corr RAM and DDC. The DDC first mixes the input IF into the baseband using an NCO, then the obtained I/Q signal is filtered in a HDF (**h**igh **d**ecimation **f**ilter) and FIR stage (**f**inite **i**mpulse **r**esponse). The I/Q output data are then stored by the DDC in the I/Q RAM. With data logging completed the I/Q data from the I/Q RAM are transferred to the host via DDC and PCI interface FPGA. The host then performs the FFT for this sweep section.

Video Bandwidths (VBW)

The video filters of FSU can be adjusted between 1 Hz and 10 MHz in steps of 1/2/3/5. They are designed as a digital lowpass filter for the video signal. The video bandwidth can either be coupled to the resolution bandwidth (= default setting) or manually set to a fixed value.

Detectors

The FSU uses a detector for the positive peak (peak+) and one for the negative peak value (peak-). In the sample mode, the video signal can also be directly sampled by the A/D converter without a peak detector being required . *Quasi-Peak, Average* and *RMS* detectors are available in addition. The RMS detector forms the rms value of the input signal for one point in the display during the measurement time.

1st Local Oszillator- RF Converter

The 1st Local is a YIG Oscillator on the RF Converter. It is synchronized via a fractional N divider to the synthesizer signal of 600...620 MHz or 20 ... 40 MHz. This signal can be set with very high resolution in steps of less than mHz. With 20 to 40 MHz a whole octave can be swept with one divider setting. Therefore this is used with fast sweep time over big spans. The other setting with app. 600 MHz is used with spans below 200 MHz because of the better phasenoise.

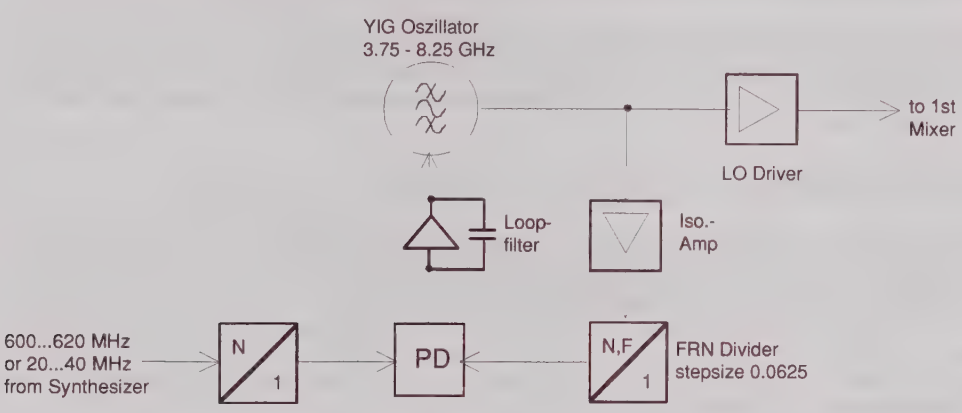


Fig. 3-7 Synchronization 1st Local Oscillator

2nd Local Oszillator- Synthesizer

The second local oscillator is a DRO (dielectric resonator oscillator) on the Synthesizer board at 4224 MHz. It can be set also to a frequency offset of up to 10 MHz to avoid mixing-products with the first local oscillator. The oscillator is synchronized to a harmonic of the 3rd LO directly or with the wanted offset. This type of oscillator was used because of the excellent phasenoise performance.

3rd Local Oszillator- Synthesizer

The third oscillator is a VCO with ceramic resonator, it is synchronized via a mixer to the third harmonic of the crystal oscillator at 128 MHz

Reference Frequency 128 MHz – Synthesizer

This reference is generated on the synthesizer board and is synchronized to the 10 MHz Reference. For best phasenoise performance a SC cut crystal is used as resonator. The oscillator is synchronized with a bandwidth of app. 30 Hz to the 10 MHz Reference or to an external reference.
Harmonics of this signal are used for the synchronization of the 3rd local oscillator and the sweep oscillator 600 ... 620 MHz. It is also used for the 128 MHz self alignment signal with a automatic level control. The level can be switched between 0 dBm and -30 dBm. The level ist adjustable with an D/A-Converter.
An 4:1 Divider is generating the 32 MHz Clock for the Detector Board (A/D-Converter).

Reference Frequency 10 MHz – Synthesizer

The reference frequency is generated by an OCXO, the frequency is adjustable by an D/A-Converter. If the input external reference is used, this OCXO is switched off and the external signal is used instead.

OCXO Reference (Option FSU-B4)

The FSU contains as an option FSU-B4 an oven controlled reference oscillator with extra low ageing and improved phasennoise at 10 Hz offset. If the option is present this OCXO is used instead of the OCXO on the synthesizer board. If an external reference is used both OCXO´s are switched off. The heater of the B4 option stays on.

Sweep VCO - Synthesizer

The sweep VCO on the synthesizer board is used to synchronize the YIG oscillator on the RF converter. A oscillator with ceramic resonator at app. 600 MHz is used. This VCO can be controlled over quite a small range of about 20 MHz for good phasenoise performance. A bigger tuning range would reduce the quality factor of the resonator. The oscillator is mixed with a comb line of the 128 MHz crystal oscillator to an IF between 20 and 40 MHz. Via this IF the VCO is synchronized to a digitally generated signal from a fractional N divider. This signal can be tuned in steps of smaller than 1mHz in frequency. For fast sweeps the output is switched to the IF.

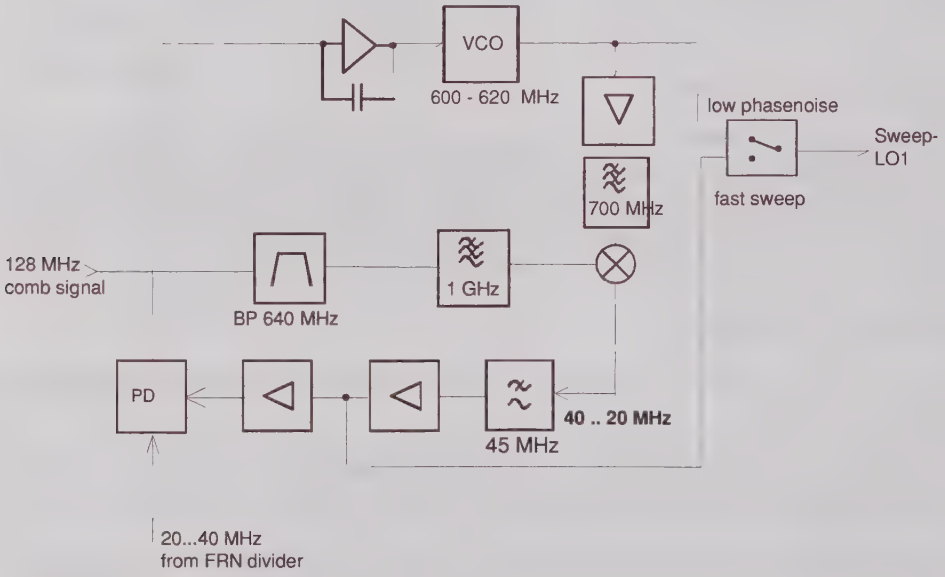


Fig. 3-8 Sweep Synthesizer

Front Panel

The Front panel consists of an aluminum case panel (part of the FSU frame) and of an mounting plate which accommodates the LCD, the backlight inverter, the keyboard mat with the membrane and the spinwheel. The case panel incorporates the front-module controller

LCD
The color LCD provides a visible output of any information, measurements etc. to the user. The resolution of the LCD is 800 * 600 pixels (SVGA).
The display incorporates a cold cathode tubes for the illumination. The high voltage required for this purpose is generated in an extra DC/AC converter mounted next to the display on the mounting plate and connected both to the display and the controller board via a cable.

Keyboard
The keyboard consisting of a keyboard mat and a membrane release a contact when the rubber key is pressed. Two LEDs for the STANDBY/ON key (orange for STANDBY/green for ON) are also accommodated on this membrane.
The key evaluation and LED control are effected via a film cable connector on the controller board. Like the control of the two LEDs, it is controlled in a special microprocessor on the controller board by means of a matrix technique. This microprocessor permits to store the status of the STANDBY/ON key when switching off using the power switch.

Front module controller
The front module controller contains all the necessary components on a board such as processor, memory chips (SIMM modules), I/O devices (ISA bus), lithium battery, IEC-bus controller (IEEE), two serial interfaces (COM1/2), a parallel interface (LPT), LCD graphics controller, external VGA monitor graphics interface (monitor) and an external keyboard connection (keyboard PS/2).
In addition, a floppy controller for an external floppy disk drive and an IDE hard disk controller are integrated on the controller board.

Hard disk
The hard disk is screwed to the rear of the aluminium case panel and connected to the printed circuit board via a ribbon cable.

Power Supply Module

The power supply module provides all currents necessary for the operation of the FSU. It can be switched off by means of the power switch on the rear panel.
The power supply module is a primary clocked switching power supply with Power Factor Correction (PFC) and Standby circuit (+12 V Standby).On the secondary side, it generates DC voltages (+3.3 V; +5.2 V; +6 V; +8 V; +12 V; +12 VFAN; +12 V Standby; +28 V; -12 V).
The control signal STANDBY/ON controlled by the front module controller (depending on the operating key STANDBY/ON on the front of the instrument frame) activates the power supply. In standby operation, it only supplies the 12V-standby voltage for the crystal oscillator and the LED STANDBY on the frontpanel.
The secondary voltages are open-circuit-proof and short-circuit-proof with respect to ground and each other.
An overtemperature protective circuit is additionally installed to prevent overheating. This status is taken to the front module controller via a status signal (*OT*).

Fuses
Two fuses are also fitted in the power supply as a means of fire protection.

Note: *These fuses are not accessible to the user from outside and are only blown in the case of a serious fault of the power supply (servicing required!).*

Motherboard

The motherboard generates the –6V supply for the analog boards with an integrated DC/DC-Converter.
The Noise source control voltage (28V Noise Source) is also generated on this board.
All external supplies (Probe, Keyboard,...) are protected by polyswitches (current-dependent, self-opening and closing fuses) or electronicly against external short circuit.
On the motherboard a circuit for temperature-dependent instrument fan control is also implemented.

Probe / Keyboard
The probe / keyboard board is located at the front of the instrument frame and serves for supply and connection of the connectors located at the front panel, the KEYBOARD (PS/2) and a PROBE POWER connector. For connection with motherboard a ribbon cable is used.

Volume / Phones
The volume/phones board is located at the front of the instrument frame and is used to connect the rotary encoder for the Volume setting of the AF-Demodulator and the Headphones connector with the motherboard.
For connection with the motherboard a ribbon cable is used.

Module Replacement

This section describes the service concept and contains the spare parts list and the basic documents for the overall FSU instrument. Replacement of modules is described in detail in Section 3 under "Module Replacement".

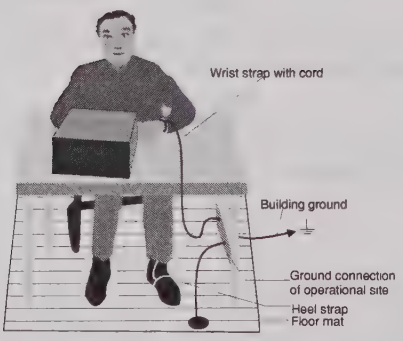
Note: *The numbers indicated in brackets refer to the position in the list of mechanical parts in Section 5.*

These items correspond to the item numbers in the illustrations on board replacement (see also Section 5):
1129.9003 (FSU Basic Model, Its. 1-455),
1129.9032 (Dig. Basic Unit, Its. 500-750),
1093.4708 (Display Unit, Its. 800-950),
1129.6791 (Option FSU-B4, Its. 1110-1130) and
1129.7246 (Option FSP-B10. Pos. 1600-1630).

Note: *The words "left" and "right" in the manual always refer to the front view of the instrument.*

Caution!

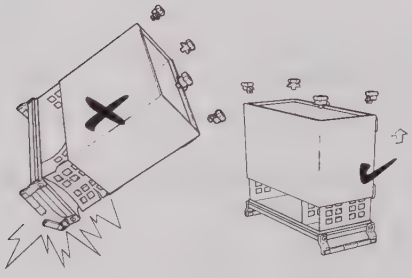
- *Please note the safety instructions at the beginning of this manual.*
- *Disconnect the instrument from the mains before opening the case.*
- *Protect the replacement site against electrostatic discharge to avoid damage of electronic components of the modules.*



The following two methods of ESD protection may be used together or separately:

- Wrist strap with cord to ground connection

- Conductive floor mat and heel strap combination



- *Put the instrument on the front handles before loosing the rear feet and the tube to avoid damage of the instrument.*
- *When mounting the tube take care not to damage or pull off cables.*

Overview of the Modules

Table 3-1 Overview - module replacement

Module	**Required tests and adjustments after replacement**		
	Function tests and system error correction	**Adjustment**	**Other**
Front module controller	SYSTEM MESSAGES/ SELFTEST / CAL		DOS/BIOS update
Lithium battery	SYSTEM MESSAGES/ SELFTEST / CAL		Cold boot
Harddisk	SYSTEM MESSAGES/ SELFTEST / CAL		Cold boot / FW update
LCD / DC/AC-converter			
Keyboard membrane or mat			
Labeling panel			
Floppy disk drive	Check of directories		
Power supply	SYSTEM MESSAGES/ SELFTEST / CAL		
Fan			
RF-Input connector	SELFTEST / CAL	Frequency response	
Motherboard	SYSTEM MESSAGES/ SELFTEST / CAL		EEPROM entry
RF-Attenuator	SYSTEM MESSAGES/ SELFTEST / CAL	Frequency response	
Key probe and Vol./Phone	Voltage / keyboard / volume		
RF Converter	SYSTEM MESSAGES/ SELFTEST / CAL	Frequency response	
Detector	SYSTEM MESSAGES/ SELFTEST / CAL		
IF-filter	SYSTEM MESSAGES/ SELFTEST / CAL	Frequency accuracy/ cal. source	
MW-Converter	SYSTEM MESSAGES/ SELFTEST / CAL	Frequency accuracy/ frequency response	
Synthesizer	SYSTEM MESSAGES/ SELFTEST / CAL		
OCXO FSU-B4	SYSTEM MESSAGES/ SELFTEST / CAL	Frequency accuracy	
External Generator Control FSP-B10	SYSTEM MESSAGES/ SELFTEST / CAL		

Replacing the Front Module Controller A90

(*see chapter 5, spare part list position (570) and explosion drawing 1129.9003, 1129.9032*)

The front module controller is mounted behind the front panel.

Opening the Instrument and Removing the Front Panel

- Switch off the instrument and pull the mains plug.
- Unscrew the four screws (430) of the front handles on both sides and take off the front handles.
- Remove volume control knob (47) by pushing off the front hood and loosing the screw. Pull off the labeling panel (270) towards the front.
- Unscrew two countersunk screws (610) in the front frame each at the top and at the bottom.
- Remove the frontpanel with keyboard and display (600, 620, 630, 640, 650, 660) to the front.

Caution!
Note the connecting cables are still connected to the controller.

- Pull off the connecting cables to the LCD, DC/AC illumination converter, keyboard membrane and spinwheel.

Note: *When pulling off the connecting cables be careful with the cable connecting to the keyboard. It is a film cable which can only be disconnected after sliding up the lock of the film cable plug.*

Removing the Front Module Controller

➢ Unscrew the ten combi screws of the front module controller board and take out the front module controller as follows (see Fig. 3-9)

Note: *The force to disconnect the controller connectors of the motherboard are very high. The pulling of the controller to the front side will be done with the help of the slits at the bottom side of the mounting plate. Please push the board with a flat, blunt tool carefully and step by step to the front.*

Caution:

Don´t move the tool to deep in the slits and press only against the pc board !. Pull out the board by preesing at alternate slits. The board must not be bend!

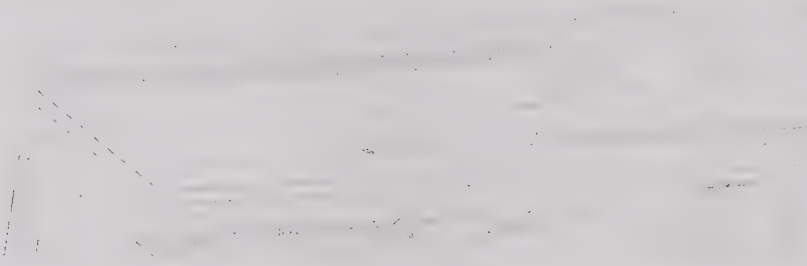


Fig. 3-9 Removing the front module controller

Installing the New Front Module Controller and Completing the Instruments

- Carefully plug the new front module controller to the motherboard and fasten it using the ten combi screws (590).
- Carefully insert the cable connectors to the controller board, taking care not to reverse the polarities.
- Remove jumper at JP28 (see Fig. 3-10).

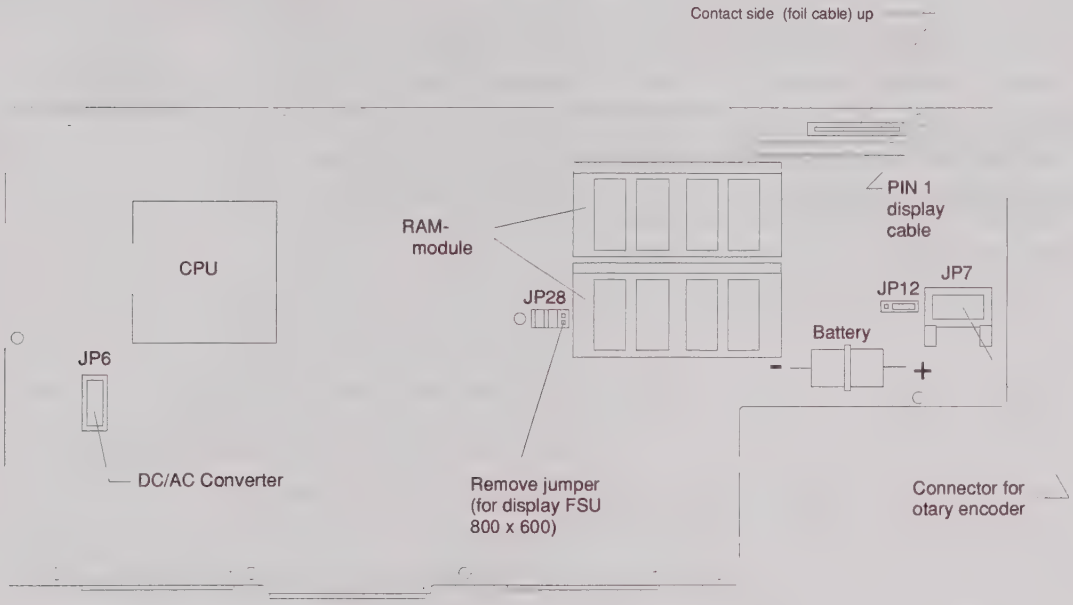


Fig. 3-10 Installing a new front module controller - position of connectors

- Plug the front panel track into the instrument and screw with four countersunk screws (610) in the front frame at the top and at the bottom.

Caution!
Make sure to route the cables properly

- Install the labeling panel (270).
- Push the 2 front handles (420) on the instrument and mount them with the 4 screws (430).
- Mount volume control knob (47) by fixing the screw and push on the front hood.

Putting into Operation

- Connect the instrument to the mains and switch on the instrument power switch. The instrument is now in stand-by mode.
- Insert a a floppy disk with DOS and BIOS-Update in the floppy disk drive.
- Switch ON the FSU and wait until the first Beep. Press Key “FILE”. The BIOS-Update starts.
- During the programming of the flash eeprom the FSU must not be switched off.
- Follow the message indicated on the display, then switch off and on the FSU.
- After starting the instrument check for system messages:
  - [**SETUP** : SYSTEM INFO : SYSTEM MESSAGES]
- Start selftest and check results:
  - [**SETUP** : SELFTEST] , then- [SELFTEST RESULT]
- Start a total calibration and check the result:
  - [**CAL** : CAL TOTAL] , then [CAL RESULTS]

Replacing the Lithium Battery on the Front Module controller

(see chapter 5, spare part list, part item *(775)* and explosion drawing *1129.9003 and 1129.9032*)

The lithium battery is accommodated on the front module controller board behind the front panel.

Caution!

Lithium batteries must not be exposed to high temperatures or fire.

Keep away from children.

If the battery is replaced improperly, there is danger of explosion. Only replace the battery by R&S type (see spare part list, pos. 775).

Lithium batteries are hazardous waste and must be disposed of in dedicated containers.

Do not short-circuit the battery!

Opening the Instrument and Removing the Front Panel

- Switch off the instrument and pull the mains plug.
- Unscrew the four screws (430) of the front handles on both sides and take off the front handles.
- Remove volume control knob (47) by pushing off the front hood and loosing the screw.
- Pull off the labeling panel (270) towards the front.
- Unscrew each two countersunk screws (610) in the front frame at the top and at the bottom.
- Remove the frontpanel with keyboard and display (600, 620, 630, 640, 650, 660) to the front.

Caution!

Note the connecting cables are still connected to the controller.

- Pull off the connecting cables to the LCD, DC/AC illumination converter, keyboard membrane and spinwheel.

Note: *When pulling off the connecting cables be careful with the cable connecting to the keyboard. It is a film cable which can only be disconnected after sliding up the lock of the film cable plug.*

Removing the Lithium Battery

- Unplug jumper JP12.
- Remove the mechanical lock (cable clamp). Carefully unsolder the negative terminal from the soldering lug first using the soldering iron (medium temperature). Then unsolder the positive terminal and take out the battery.

Note: *The lithium battery is of the type 3.4 V (∅ 15mm * 25mm) with soldering lug terminals (R&S ordering number 0565.1687.00.)*

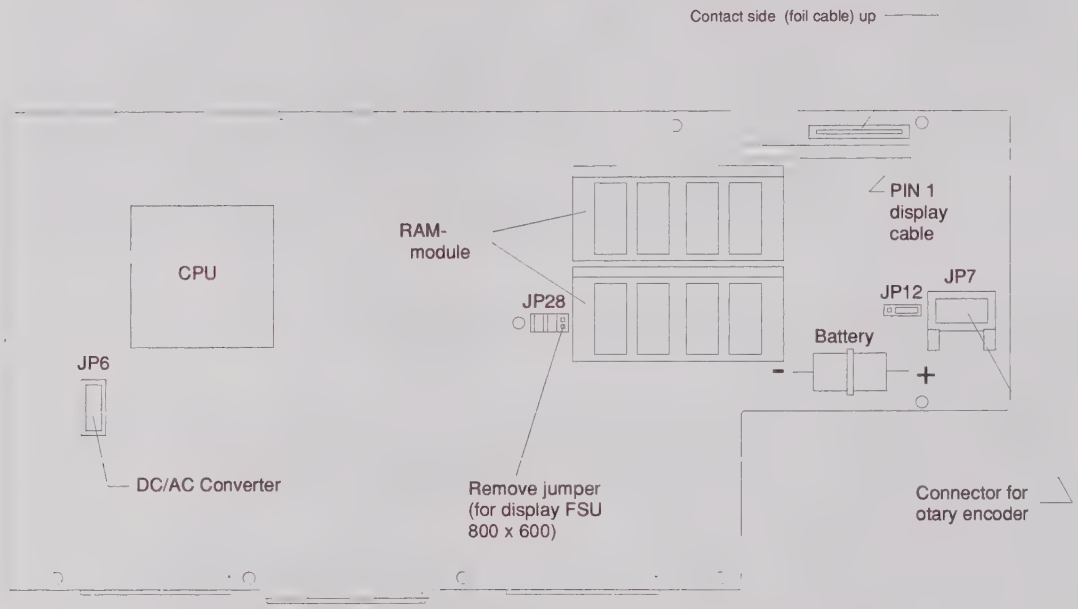


Fig. 3-11 Position of lithium battery and jumper 12 on the front module controller

Installing the New Battery and Completing the Instrument

- Shorten the connecting wires of the new battery to a right length and replace with the correct polarity.

Warning!
Do not short-circuit the battery!

- If necessary, replace the mechanical lock (cable clamp). First solder the positive terminal to the PC board, then the negative terminal.
- Plug jumper JP12 to position 1 and 2 (position before battery replacement) (see Fig. 3-11).
- Plug the front panel track into the instrument and screw with four countersunk screws (610) in the front frame at the top and at the bottom.

Caution!
Make sure to route the cables properly

- Install the labeling panel (270).
- Push the 2 front handles (420) on the instrument and mount them with the 4 screws (430).
- Mount volume control knob (47) by fixing the screw and push on the front hood, if existing.

Putting into Operation

- Connect the instrument to the mains and switch on the instrument power switch. The instrument is now in stand-by mode.
- After the change of the battery a cold boot is necessary. Press the decimal point key while switching on the instrument with the ON/STANDBY-Key, until the FSU is beeping.
- After starting the instrument check for system messages:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES **]**
- Start selftest and check results:
  - [SETUP : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Start a total calibration and check the result:
  - [**CAL** : CAL TOTAL], then [CAL RESULTS]

Replacing the Harddisk A60

(see chapter 5, *spare part list, item (710), and explosion drawing 129.9003 und 1129.9032)*

The hard disk is incorporated between the front module and the analog boards.
The spare part is already formatted for the FSU and contains the complete software.

Opening the Instrument and Removing the Harddisk

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and push the tube (410) backwards and take off.
- Unscrew the 10 countersunk screws (260) at the top of the instrument and the 3 combi screws (250) at the fan side, lift the cover at the top (240) of the instrument to the left side and take off.
- Disconnect the ribbon cable (720) at the harddisk.
- Unscrew the two countersunk screws (740) on the harddisk mounting plate (730).
- Take the harddisk (710) completely with the harddisk mounting plate (730 out of the FSU.
- Unscrew the four countersunk screws (750) remove the harddisk and mount a new harddisk to the mounting plate (730).

Installing the New Hard Disk and Putting into Operation

- Fit the harddisk and the disk holder with two screws (740) to the instrument

  Note: *Be careful with the lower cover plate locking in the concerning opening.*
- Connect the ribbon cable (720) to the harddisk.

  Note: *Connect cable as drawing 1129.9032.*
- Put the top cover (240) on the instrument and mount it with 10 countersunk screws (260) and 3 combi screws (250).
- Push the tube (410) on the instrument and mount the 4 rear-panel feet (450).
- Connect the instrument to the mains and switch on the instrument power switch. The instrument is now in stand-by mode.
- After the change of the harddisk a cold boot is necessary. Press the decimal point key while switching on the instrument with the ON/STANDBY-Key, until the FSU is beeping three times.
- After starting the instrument check for system messages:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES **]**
- Start selftest and check results:
  - [SETUP : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Start a total calibration and check the result:
  - [**CAL** : CAL TOTAL] , then [CAL RESULTS]

Replacing the LCD and/or DC/AC Converter in the Front Module

(see chapter 5, *spare part list item (600), (871), (921) and explosion drawing 1129.9003, 1129.9032, 1093.4708*)

The LCD is accommodated on the mounting plate together with the associated DC/AC converter. It is connected to the front module controller via cables, which can also be replaced individually. For replacement proceed as follows:

Opening the Instrument and Removing the Front Module

- Switch off the instrument and pull the mains plug.
- Unscrew the four screws (430) of the front handles on both sides and take off the front handles.
- Remove volume control knob by pushing off the front hood and loosing the screw.
- Pull off the labeling panel (270) towards the front.
- Unscrew two countersunk screws (610) in the front frame each at the top and at the bottom.
- Remove the frontpanel with keyboard and display (600, 620, 630, 640, 650, 660) to the front.

Caution!
Note the connecting cables are still connected to the controller

- Pull off the connecting cables to the LCD, DC/AC illumination converter, keyboard membrane and spinwheel.

  Note: *When pulling off the connecting cables be careful with the cable connecting to the keyboard. It is a film cable which can only be disconnected after sliding up the lock of the film cable plug.*

- Place the Front Module onto a clean surface.

Removing the DC/AC Converter

- Pull off the plug of the connecting cable to the DC/AC converter (871).
- Unscrew the two screws (890) and remove the DC/AC-Converter (870) with the *spacing pieces* (900).

Removing the LCD

- Remove display cable (945) after cutting thename plate (946).
- Unscrew the four screws (930) at the display (921) and remove the display.

Installing the New LCD and/or DC/AC converter and Completing the Instrument

- Insert new LCD and/or DC/AC converter in the reverse order, connect all connecting cables in the correct position and replace all screws (drawing 1093.4708).
- After excange of the display (921)or display cable (945), affix new label (946) to protect label.
- Place the front panel with the keys on the top of the instrument, with the cables in the right direction to the front modul controller.
- Carefully plug the cable connectors to the controller board without reversing the polarities and replace the mounting plate in the reverse order.

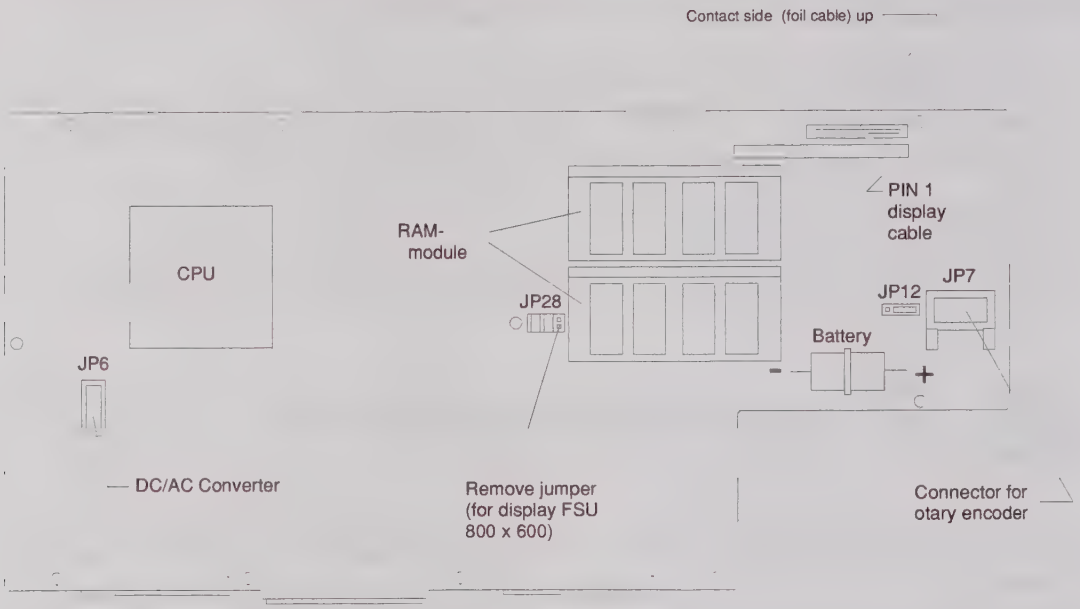


Fig. 3-12 Position of connectors on front module controller

- Plug the front panel track into the instrument and screw with four countersunk screws (610) in the front frame at the top and at the bottom.

Caution!
Make sure to route the cables properly.

- Install the labeling panel (270).
- Push the 2 front handles (420) on the instrument and mount them with the 4 screws (430).
- Mount volume control knob (47) by fixing the screw and push on the front hood, if existing.
- Connect the instrument to the mains, switch on the instrument power switch and switch on the instrument with the ON-Key

Replacing the Keyboard Membrane or Mat on the Front Module

(see chapter 5, *spare part list item (630) and (640), and explosion drawing 1129.9003, 1129.9032)*

The keyboard membrane is the contact film for the rubber keys (mat) behind the labeling panel and the keyboard frame. For replacement proceed as follows:

Opening the Instrument and Removing the Front Panel

- Switch off the instrument and pull the mains plug.
- Unscrew the four screws (430) of the front handles on both sides and take off the front handles.
- Remove volume control knob (47) by pushing off the front hood and loosing the screw
- Pull off the labeling panel (270) towards the front.
- Unscrew each two countersunk screws (610) in the front frame at the top and at the bottom.
- Remove the frontpanel with keyboard and display (600, 620, 630, 640, 650, 660) to the front and rotate it to the top of the instrument.

Caution!
Note the connecting cables are still connected to the controller .

- Pull off the connecting cables to the LCD, DC/AC illumination converter, keyboard membrane and spinwheel.

Note: *When pulling off the connecting cables be careful with the cable connecting to the keyboard. It is a film cable which can only be disconnected after sliding up the lock of the film cable plug.*

Removing the membrane

- Place the mounting plate onto the surface with the keyboard frame pointing upwards.
- Pull off the knob (650) of the spinwheel.
- Unscrew the 10 countersunk screws (660) and remove the keyboard frame (620).
- The keyboard membrane (640) as well as the mat (630) is now accessible.

Installing the New membrane and Completing the Instrument

➢ Put the new mat (630) into the keyboard frame (620).

Note: *The pins of the mat must be pressed in the wholes at the keyboard frame.*

➢ Locate the new keyboard membrane (640) on the back of the mat (630) .

Note: *Push the foil cable of the membrane through the slit in the mounting panel. The membrane must be positioned to let the pins of the mat come trough the holes in the membrane.*

➢ Locate the mounting plate with the display (600) onto the membrane (640) .

Note: *The mounting plate must be positioned to let the pins of the mat come trough the holes in the mounting plate (800).*

➢ Press the front panel together, turn the keys to the top and screw ten countersunk screws (660) into the keyboard frame.

➢ Place the front panel with the keys on the top of the instrument, with the cables in the right direction to the front modul controller.

➢ Carefully plug the cable connectors to the controller board without reversing the polarities and replace the mounting plate in the reverse order.

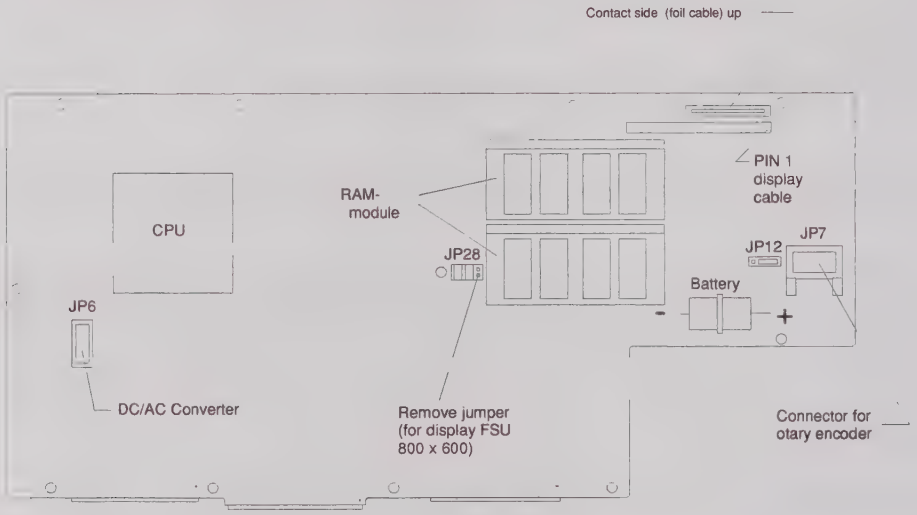


Fig. 3-13 Position of connectors on front module controller

➢ Plug the front panel track into the instrument and screw with four countersunk screws (610) in the front frame at the top and at the bottom.

Caution!
Make sure to route the cables properly.

➢ Install the labeling panel (270).

➢ Push the 2 front handles (420) on the instrument and mount them with the 4 screws (430).

➢ Mount volume control knob (47) by fixing the screw and push on the front hood, if existing.

➢ Connect the instrument to the mains, switch on the instrument power switch and switch on the instrument with the ON-Key

Replacing the Labeling Panel on the Front Module

(see chapter 5, spare part list item (270/280), and explosion drawing 1129.9003)

The labeling panel is the outer front panel which carries the labeling of all the parts on the front side of the FSU. Every model has its own labeling panel (270, 280, 290)

- Switch off the instrument and pull the mains plug.
- Unscrew the four screws (430) of the front handles on both sides and take off the front handles.
- Remove volume control knob (47) by pushing off the front hood and loosing the screw.
- Pull off the labeling panel (270) towards the front.
- Install the New labeling panel and tighten all screws.
- Complete the instrument.
- Connect the instrument to the mains, switch on the instrument power switch and switch on the instrument with the ON/STANDBY-Key

Replacing the Floppy Disk Drive A30

(see chapter 5, spare part list item (670), and explosion drawing 1129.9003, 1129.9032)

Opening the Instrument and Removing the Floppy Disk Drive

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and push the tube (410) backwards and take off.
- Unscrew the 10 countersunk screws (260) at the top of the instrument and the 3 combi screws (250) at the fan side, lift the cover at the top (240) of the instrument to the left side and take off.
- Remove 3 screws (700) at the fan side of the FSU and carefully pull out the Floppy Disk Drive (670) with Floppy mounting plate (680) to the upper side.
- Disconnect the cable (690 and 691) at the floppy disk drive .

Install the New Floppy Disk Drive and Completing the Instrument

- Unscrew the three combi screws (700) and remove the floopy disk from the mounting plate (680) and mount a new disk drive (670) to the floppy mounting plate (680).
- Connect the foil cable (690 and 691) to the disk drive.
- Insert the floppy mounting plate (680) and mount it to the fan side with 3 combi screws (700).

  Note: *Please mount the floppy disk drive in the middle of the front panel break out.*
- Put the top cover (240) on the instrument and mount it with 10 countersunk screws (260) and 3 combi screws (250).
- Push the tube (410) on the instrument and mount the 4 rear-panel feet (450).
- Connect the instrument to the mains, switch on the instrument power switch and switch on the instrument with the ON/STANDBY-Key

Function Test

- Instrument is booting and the firmware is starting.
- Insert 3 ½ ″ Disk with any files.
- Press key ‚FILE' , then Softkey ‚File Manager' and ‚Edit Path'.
- Enter " a " and " : " and confirm with "Enter"-key.
- The file structure of the inserted disk must be displayed.

Replacing the Power Supply A20

(see chapter 5, spare part list item (550), and explosion drawing 1129.9032)

The power supply is fitted at the rear of the instrument frame of the FSU.

Removing the Power Supply

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and push the tube (410) backwards and take off.
- Unscrew the ten screws (560) at the rear of the power supply.
- Pull out the power supply approx. 20 mm towards the rear, slightly tilt towards the bottom and then pull out completely.

Installing the New Power Supply

- Install the New power supply in the reverse order.

  Note: *Make sure that the 96-contact connector to the MOTHERBOARD locks in place correctly.*
- Push the tube (410) on the instrument and mount the 4 rear-panel feet (450).
- Connect the instrument to the mains and switch on.
- After starting the instrument check for system messages:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES **]**
- Start selftest and check results:
  - [SETUP : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Start a total calibration and check the result:
  - [**CAL** : CAL TOTAL] , then [CAL RESULTS]

Replacing the Fan

(see chapter 5, spare part list item (15), and explosion drawing 1129.9003)

The fan is fitted at the right side of the frame.

Opening the Instrument and Removing the Fan

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and push the tube (410) backwards and take off.
- Unscrew the 10 countersunk screws (260) at the top of the instrument and the 3 combi screws (250) at the fan side, lift the cover at the top (240) of the instrument to the left side and take off.
- Disconnect the fan cable at the motherboard connector X35 (FAN) .
- Unscrew the four screws off the FAN (15) and remove the fan.

Installing the New Fan and Completing the Instrument

- Connect the fan cable at the motherboard connector X35 (FAN)
- Insert the new fan and mount it to the frame with 4 pieces fan screws.

  Note: *Please note the direction of the airflow printed on the fan. The fan must blow the cold air into the instrument.*
  Make sure to route the cables with enough space to the fan.
- Put the top cover (240) on the instrument and mount it with 10 countersunk screws (260) and 3 combi screws (250).
- Push the tube (410) on the instrument and mount the 4 rear-panel feet (450).
- Connect the instrument to the mains, switch on the instrument power switch and switch on the instrument with the ON-Key

Replacing the RF Input Connector (Cable W1)

(see chapter 5, spare part list item (295), and explosion drawing 1129.9003)

The RF input connector is fitted at the right lower side of the front panel.
Depending on the frequency range two different models of the connector are available.

Opening the Instrument and Removing the Cable W1

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and push the tube (410) backwards and take off.
- Unscrew the four screws (430) of the front handles on both sides and take off the front handles.
- Remove volume control knob (47) by pushing off the front hood and loosing the screw.
- Pull off the labeling panel (270) towards the front.
- Remove three countersunk screws (70) at the frame and 1 countersunk screw (70) at the connector mounting plate (60).
- Unscrew the cable W1 (295) to 8 GHz at the RF attenuator (20).
- Remove the connector mounting plate (60) together with W1 and modules Probe/Key (50) and Vol./Phone Board (43) to the front.

  Note: *The modul Probe/Key (50 and Vol./Phone Board (43) are connected via a ribbon cable to the motherboard X80, X81.*
- Unscrew the four countersunk screws (350) and remove cable W1 together with mounting plate (330).

Installing the New Cable and Completing the Instrument

- Put the mounting plate (330) onto the new cablel W1 and mount the connector with four countersunk screws (350), move the mounting plate (60) back to the instrument and connect cable W1 to the input of RF attenuator.
- Screw three countersunk screws (70) to the instrument frame and one countersunk screw (70) to the mounting plate (60).
- Install the labeling panel (270).
- Push the 2 front handles (420) on the instrument and mount them with the 4 screws (430).
- Mount volume control knob (47) by fixing the screw and push on the front hood.
- Push the tube (410) on the instrument and mount the 4 rear-panel feet (450).
- Connect the instrument to the mains, switch on the instrument power switch and switch on the instrument with the ON/STANDBY-Key
- Start selftest and check results:
  - [SETUP : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Start a total calibration and check the result:
  - [**CAL** : CAL TOTAL] , then [CAL RESULTS]
- Check frequency response with chapter 1 and do a correction if necessary.

Replacing the Motherboard A10

(see chapter 5, spare parts list item (510) and explosion drawing 1129.9003, 1129.9032)

The motherboard is fitted from the bottom side.

Opening the Instrument and Removing the Motherboard

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and push the tube (410) backwards and take off.
- Unscrew the 10 countersunk screws (260) at the top of the instrument and the three combi screws (250) at the fan side, lift the cover at the top (240) of the instrument to the left side and take off.
- Place the instrument on the left side frame and loosen all connecting cables to the boards.
- Push out all boards to the top side of the instrument.

  Note: The boards can be moved up by pressing carefully from the downside through the connector wholes in the motherboard against the boards.
- Removing the power supply(550). Unscrew the ten screws (560) at the rear of the power supply. Pull out the power supply approx. 20 mm towards the rear, slightly tilt towards the bottom and then pull out completely.
- Unscrew the four screws (430) of the front handles on both sides and take off the front handles.
- Remove volume control knob (47) by pushing off the front hood and loosing the screw.
- Pull off the labeling panel (270) towards the front.
- Unscrew each two countersunk screws (610) in the front frame at the top and at the bottom.
- Remove the frontpanel with keyboard and display (600, 620, 630, 640, 650, 660) to the front and rotate it to the top of the instrument.

Caution:
Note the connecting cables are still connected to the controller .

- Pull off the connecting cables to the LCD, DC/AC illumination converter, keyboard membrane and spinwheel.

  Note: *When pulling off the connecting cables be careful with the cable connecting to the keyboard. It is a film cable which can only be disconnected after sliding up the lock of the film cable plug.*
- Remove the front modul controller (see chapter: Replacing the Front Module Controller A90)
- Remove the screws of all motherboard connectors at the rear panel . Unscrew the bolts (530) at the "COM" and "LPT" ports and (540) aa "Monitor" port. Unscrew the nuts at "SWEEP" and "Ext. TRIGGER" connectors and the bolts at the "IEC"-port.

  Note: *Don´t change the bolts of the "Monitor" and the "LPT" or "COM" !*
- Pull off the connecting cables at the motherboard (RF-Attenuator, fan, Floppy, Probe/Key, rear panel, Vol./Phone Board ....).
- Unscrew 7 combi screws in bottom side of the Motherboard
- Move the Motherboard (510) carefully to th front panel (ca. 15 mm) and lift it out of the instrument to the downside.

Installing the New Motherboard and Completing the Instrument

- Insert the Motherboard into the instrument in the reverse order.

  Note: *Please move the Motherboard carefully to the rear panel without causing damage to the parts on the board.*

  Connect all cables (see label on cable for position).

- Insert the Frontmodulcontroller, Frontpanel, power supply, boards and cables, top cover, tube and rear panel feet in reverse order.
- Connect the instrument to the mains, switch on the instrument power switch and switch on the instrument with the ON/STANDBY-Key
- After starting the instrument check for system messages:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES **]**
- Start selftest and check results:
  - [SETUP : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Start a total calibration and check the result:
  - [**CAL** : CAL TOTAL] , then [CAL RESULTS]
- Store the serial number of the instrument to the Eeprom:
  - [**SETUP** : SERVICE : ENTER PASSWORD "30473035"] , then input serial number of the instrument in HW-Info table (see also Chapter 2, Section "Automatic Adjustment of Module Data").

Replacing the Module RF Attenuator A40

(see chapter 5, spare parts list item (20/30) and explosion drawing 1129.9003)

The RF attenuator is fitted at the bootom side behind the RF input connector.
There are different models of the attenuator for instruments to 7GHz (20) and to 30GHz (30).

Opening the Instrument and Removing the RF Attenuator

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and push the tube (410) backwards and take off.
- Place the instrument on the left side and unscrew the RF cable or the diplexer (150) at the RF output of the RF Attenuator.
- Unscrew the two combi screws (40) at the right frame.
  ***Note**: The RF Attenuator will only be fixed with the RF cables at the front.*
- Disconnect RF-cable W1 (295) or (315) at the input of the RF Attenuator.
- Move carefully out the RF Attenuator and disconnect the flexible RF-cable at the input.
- Disconnect ribbon cable at motherboard connector X40.

Installing the New RF Attenuator and Completing the Instrument

- Connect the ribbon cable of the new RF Attenuator (20) or (30) at motherboard connector X40.
- Connect the flexible RF-cable at the input of new RF Attenuator (see label on cable)
- Move the new RF Attenuator in the instrument and connect cable W1 (295) or (315) at the input.
- Screw the two combi screws (40) at the right frame in the RF-Attenuator.
- Screw the RF cable or the diplexer (150) at the RF output of the RF Attenuator.
- Push the tube (410) on the instrument and mount the 4 rear-panel feet (450).
- Connect the instrument to the mains, switch on the instrument power switch and switch on the instrument with the ON/STANDBY-Key
- After starting the instrument check for system messages:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES]
- Start selftest and check results:
  - [SETUP : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Start a total calibration and check the result:
  - [**CAL** : CAL TOTAL] , then [CAL RESULTS]
- Check frequency response with chapter 1 and make a correction if necessary.

Replacing the Module Key/Probe A80 and Vol./Phone Board A191

(see chapter 5, spare parts list item (43, 50 and 1040) and explosion drawing 1129.9003)

The boards are fitted behind the front panel connectors Keyboard, Probe, Headphone and the volume control knob.

Opening the Instrument and Removing the Boards

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and push the tube (410) backwards and take off.
- Unscrew the four screws (430) of the front handles on both sides and take off the front handles.
- Remove volume control knob (47) by pushing off the front hood and loosing the screw.
- Pull off the labeling panel (270) towards the front.
- Remove three countersunk screws (70) at the frame and 1 countersunk screw (70) at the connector mounting plate (60).
- Unscrew the cable W1 (295) at the RF attenuator (20).
- Remove the mounting plate (60) completely with W1 and Probe/Key board (50) and Vol./Phone Board (43) to the front side.

  ***Note**: The Probe/Key (50) and Vol./Phone boards (43) are connected with a ribbon cable to the motherboard X80 und X81.*
- Disconnect the ribbon cable at the motherboard connector X80 and X81.
- Unscrew the 4 countersunk screws (55) and remove the board Key-Probe (50).
- Unscrew the three countersunk screws (46) and remove the board Vol./Phone Board (43) from mounting plate (60) .
- Unscrew the combi screw (45) and the nut of the volume control at the mounting plate (44) and remove Vol./Phone Board (43) .

Installing the New Modules and Completing the Instrument

- Mount the new Key-Probe board (50) with 4 countersunk screws (55) to mounting plate (60).
- Mount the new Vol./Phone Board (43) with tne nut of the volume control and one countersunk screw (45) to the mounting plate (44). Mount Vol./Phone board (43) with two countersunk screws (46) to mounting plate (60).
- Connect the ribbon cable at motherboard-connector X80 and X81.
- Move the complete mounting plate (60) carefully back in the instrument.

Caution

Make sure to route the cables properly.

- Connect RF-cable W1 (295) or (315) at the input of the RF Attenuator (20) or (30).
- Screw three countersunk screws (70) to the instrument frame and one countersunk screw (70) to the mounting plate (60).
- Install the labeling panel (270).
- Push the 2 front handles (420) on the instrument and mount them with the 4 screws (430).
- Mount volume control knob (47) by fixing the screw and push on the front hood.
- Push the tube (410) on the instrument and mount the 4 rear-panel feet (450).

Function Test

- Connect the instrument to the mains, switch on the instrument power switch and switch on the instrument with the ON/STANDBY-Key
- Measure the output voltage at the Probe-connector (see Fig. 3-14).
- Connect a keyboard to the instrument and test the function.
- If the option FSU-B3 (AF-Demodulator) is fitted, test the function of headphone connector and volume control. Press the Key *MKR,* press Softkey *MARKER DEMOD.* Noise can be heard in the loudspeaker, the volume can be changed with the *VOLUME* knob at the front panel. Connect a headphone to the *AF OUTPUT* at the frontpanel, the loudspeaker must be switched off and the noise can be heared in the headphone.

Pin	Signal
1	GND
2	-12.6 V
3	+15 V

Fig. 3-14 Pin assignments of PROBE POWER connector

Replacing the RF RF Converter A100

(see chapter 5, spare part list item (100), and explosion drawing 1129.9003)

The RF RF Converter is installed in the middle of the instrument .

Opening the Instrument and Removing the Board

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and push the tube (410) backwards and take off.
- Unscrew the 10 countersunk screws (260) at the top of the instrument and the 3 combi screws (250) at the fan side, lift the cover at the top (240) of the instrument to the left side and take off.
- Place the instrument on the left side frame and loosen all connecting cables to the board.
- Push out board to the top side of the instrument.

Note: *The board can be moved up by pressing carefully from the downside through the connector wholes in the motherboard against the board.*

Installing the New RF RF Converter Module and Completing the Instrument

- Plug the new board into the instrument and reconnect all cables to the board.
  Note: *Please refer to the cable wiring drawing on the motherboard.*
- Put the top cover (240) on the instrument and mount it with 10 countersunk screws (260) and 3 combi screws (250).
- Push the tube (410) on the instrument and mount the 4 rear-panel feet (450).
- Connect the instrument to the mains, switch on the instrument power switch and switch on the instrument with the ON/STANDBY-Key
- After starting the instrument check for system messages:
  - [**SETUP** : SYSTEM INFO : SYSTEM MESSAGES **]**
- Start selftest and check results:
  - [SETUP : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Start a total calibration and check the result:
  - [**CAL** : CAL TOTAL] , then [CAL RESULTS]
- Check frequency response with chapter 1 and make a correction if necessary, using the correction software.

Replacing the Sythesizer A110

(see chapter 5, spare part list item (105), and explosion drawing 1129.9003)

The board is installed in the front part of the instrument.

Opening the Instrument and Removing the Board

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and push the tube (410) backwards and take off.
- Unscrew the two countersunk screws (260) at the top of the instrument and the two combi screws (250) at the fan side, lift the cover at the top (240) of the instrument to the left side and take off.
- Place the instrument on the left side frame and loosen all connecting cables to the board.
- Push out board to the top side of the instrument.

  Note: *The board can be moved up by pressing carefully from the downside through the connector wholes in the motherboard against the board.*

Installing the New Module and Completing the Instrument

- Plug the new board into the instrument and reconnect all cables to the board.

  Note: *Please refer to the cable wiring drawing on the motherboard.*
- Put the top cover (240) on the instrument and mount it with two countersunk screws (260) and 2 combi screws (250).
- Push the tube (410) on the instrument and mount the 4 rear-panel feet (450).
- Connect the instrument to the mains, switch on the instrument power switch and switch on the instrument with the ON/STANDBY-Key
- After starting the instrument check for system messages:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES **]**
- Start selftest and check results:
  - [SETUP : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Start a total calibration and check the result:
  - [**CAL** : CAL TOTAL] , then [CAL RESULTS]
- Check frequency response according to chapter 1 and readjust with correction software if necessary.

Replacing the Detector A140

(see chapter 5, spare part list item (105), and explosion drawing 1129.9003)

The board is installed in the front part of the instrument.

Opening the Instrument and Removing the Board

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and push the tube (410) backwards and take off.
- Unscrew the two countersunk screws (260) at the top of the instrument and the two combi screws (250) at the fan side, lift the cover at the top (240) of the instrument to the left side and take off.
- Place the instrument on the left side frame and loosen all connecting cables to the board.
- Push out board to the top side of the instrument.

Note: *The board can be moved up by pressing carefully from the downside through the connector wholes in the motherboard against the board.*

Installing the New Module and Completing the Instrument

- Plug the new board into the instrument and reconnect all cables to the board.
  Note: *Please refer to the cable wiring drawing on the motherboard.*
- Put the top cover (240) on the instrument and mount it with 10 countersunk screws (260) and 3 combi screws (250).
- Push the tube (410) on the instrument and mount the 4 rear-panel feet (450).
- Connect the instrument to the mains, switch on the instrument power switch and switch on the instrument with the ON/STANDBY-Key
- After starting the instrument check for system messages:
  - [**SETUP** : SYSTEM INFO : SYSTEM MESSAGES **]**
- Start selftest and check results:
  - [SETUP : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Start a total calibration and check the result:
  - [**CAL** : CAL TOTAL] , then [CAL RESULTS]

Replacing the IF-Filter A130

(see chapter 5, spare part list item (120), and explosion drawing 1129.9003)

The board is installed in the middle of the instrument.

Opening the Instrument and Removing the Board

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and push the tube (410) backwards and take off.
- Unscrew the 10 countersunk screws (260) at the top of the instrument and the 3 combi screws (250) at the fan side, lift the cover at the top (240) of the instrument to the left side and take off.
- Place the instrument on the left side frame and loosen all connecting cables to the board.
- Push out board to the top side of the instrument.

Note: *The board can be moved up by pressing carefully from the downside through the connector holes in the motherboard against the board.*

Installing the New Module and Completing the Instrument

- Plug the new board into the instrument and reconnect all cables to the board.
  Note: Please refer to the cable wiring drawing on the motherboard.
- Put the top cover (240) on the instrument and mount it with 10 countersunk screws (260) and 3 combi screws (250).
- Push the tube (410) on the instrument and mount the 4 rear-panel feet (450).
- Connect the instrument to the mains, switch on the instrument power switch and switch on the instrument with the ON/STANDBY-Key
- After starting the instrument check for system messages:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES **]**
- Start selftest and check results:
  - [SETUP : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Start a total calibration and check the result:
  - [**CAL** : CAL TOTAL] , then [CAL RESULTS]
- Check frequency accuracy and the calibration source level with chapter 1 and readjust with chapter 2 if necessary.

Replacing the MW-Converter Unit A160

(see chapter 5, spare part list item (130 to 140), and explosion drawing 129.9003)

The board is installed in the middle of the instrument.

Opening the Instrument and Removing the Board

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and push the tube (410) backwards and take off.
- Unscrew the 10 countersunk screws (260) at the top of the instrument and the 3 combi screws (250) at the fan side, lift the cover at the top (240) of the instrument to the left side and take off.
- Place the instrument on the left side and loosen all cables at the bottom to the board.
- Push out board to the top side of the instrument.

  Note: *The board can be moved up by pressing carefully from the downside through the connector wholes in the motherboard against the board.*

Installing the New Module and Completing the Instrument

- Plug the new board into the instrument and reconnect all cables to the board.

  Note: *Please refer to the cable wiring drawing on the motherboard.*
- Put the top cover (240) on the instrument and mount it with 10 countersunk screws (260) and 3 combi screws (250).
- Push the tube (410) on the instrument and mount the 4 rear-panel feet (450).
- Connect the instrument to the mains, switch on the instrument power switch and switch on the instrument with the ON/STANDBY-Key
- After starting the instrument check for system messages:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES **]**
- Start selftest and check results:
  - [SETUP : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Start a total calibration and check the result:
  - [**CAL** : CAL TOTAL] , then [CAL RESULTS]
- Start frequency correction of the YIG-Filter (external correction software).
- Start frequency response correction of all frequency ranges (external correction software).

Replacing the OCXO A200 (Option FSU-B4)

(see chapter 5, spare part list item (1100), and explosion drawing 1093.4495 and 1129.6791)

The board is fitted in the front part behind the front module .

Opening the Instrument and Removing the Board

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and push the tube (410) backwards and take off.
- Unscrew the two countersunk screws (260) at the top of the instrument and the two combi screws (250) at the fan side, lift the cover at the top (240) of the instrument to the left side and take off.
- Place the instrument on the left side frame and loosen all connecting cables to board.
- Push out board to the top side of the instrument.

  Note: *The board can be moved up by pressing carefully from the downside through the connector wholes in the motherboard against the board.*

Installing the New Module and Completing the Instrument

- Plug the new board into the instrument and reconnect all cables to the board.

  Note: *Please refer to the cable wiring drawing on the motherboard.*
- Put the top cover (240) on the instrument and mount it with two countersunk screws (260) and 2 combi screws (250).
- Push the tube (410) on the instrument and mount the 4 rear-panel feet (450).
- Connect the instrument to the mains, switch on the instrument power switch and switch on the instrument with the ON/STANDBY-Key
- After starting the instrument check for system messages:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES **]**
- Start selftest and check results:
  - [SETUP : SERVICE : SELFTEST], then [SELFTEST RESULT]
- Start a total calibration and check the result:
  - [**CAL** : CAL TOTAL] , then [CAL RESULTS]
- Check frequency response according to chapter 1 and readjust with correction software if necessary.

Replacing the External Generator Control A210 (Option FSP-B10)

(see chapter 5, spare part list item (1600), and explosion drawing 1093.4495 and 1129.7298)

The board is fitted in the front part of the instrument .

Opening the Instrument and Removing the Board

- Switch off the instrument, pull the mains plug, unscrew the 4 rear-panel feet (450) and push the tube (410) backwards and take off.
- Unscrew the 10 countersunk screws (260) at the top of the instrument and the 3 combi screws (250) at the fan side, lift the cover at the top (240) of the instrument to the left side and take off.
- Push out board to the top side of the instrument.

Installing the New Module and Completing the Instrument

- Plug the new board into the instrument.
- Put the top cover (240) on the instrument and mount it with 10 countersunk screws (260) and 3 combi screws (250).
- Push the tube (410) on the instrument and mount the 4 rear-panel feet (450).
- Connect the instrument to the mains, switch on the instrument power switch and switch on the instrument with the ON/STANDBY-Key
- After starting the instrument check for system messages:
  - [**SETUP :** SYSTEM INFO : SYSTEM MESSAGES **]**

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Troubleshooting

Malfunctions may have simple causes but also may be caused by faulty components.

These troubleshooting instructions allow for locating the error causes down to board level and make the instrument ready for use again by means of board replacement.

We recommend to ship the instrument to our experts in the service centers (cf. address list) for module replacement and further error elimination.

Warning!

Do not plug or unplug boards prior to disconnecting them from ac supply!

Be careful not to cause short-circuits when measuring voltages!

The following utilities are provided in the FSU for diagnosis purposes:

- Permanent monitoring of levels and frequencies in the instrument
- Selftest
- System error correction

Note: *When problems occur, first check, whether any connections (cables, plug-in connections of boards etc.) are damaged or wrongly connected.*

Measuring Equipment and Accessories

Item	Type of equipment	Specifications recommended	Equipment recommended	R&S-Order No.	Use
1	DC meter		URE	0350.5315.02	Troubleshooting
2	Spectrum analyzer	Frequency range 0 to 7GHz	FSEB 20	1066.3010.20	Troubleshooting
3	Adapting cable	1m long SMP- to SMA connection	-	1129.8259.00	Troubleshooting
4	Adapting cable	0,5m long SMP-to SMP-connection	-	1129.8265.00	Troubleshooting
5	Adapter board	Extension 150mm high 48-contact, 2mm spacing	-	1100.3542.02	Troubleshooting

Troubleshooting Switch-on Problems

- **Error: FSU cannot be switched on.**

Action	Possible error causes and further steps
Check power-on switch on the rear ⇓	Power switch OFF: Switch on power supply..
Check yellow LED (Stand-by). ⇓	LED remains dark: ➢ Measure voltage at X20.D24 (power supply unit) Rated value: +12 V ± 1V Voltage o.k.: Keyboard or controller faulty. No voltage: remove analog modules one by one. ➢ Measure voltage at X20.D24 (power supply unit): Rated value: +12 V ± 1V Correct voltage: Removed module faulty No voltage: Power supply faulty or short-circuit at 12V standby.
Switch on instrument. Check green LED ⇓	LED remains dark: Measure PWR-ON signal on the power supply X20.B1: < 1V for ON Voltage > 1V: Keyboard membrane or controller faulty.
Power supply starts, screen remains dark?	Measure voltages on the motherboard, see "Short-circuit of one or more operating voltages".

- **Error: Short-circuit of one or more operating voltages**

Action	Possible error causes and further steps
Check on the bottom of the motherboard which of the voltages is short-circuited: Computer, hard disk, Eeproms : X20.A7 bis A10: rated value: +5 V2 Detector board : X20.A5 und X20.A6: rated value +3 V3 Analog boards: X130.A10: rated value +12 V X130.A9: rated value +8 V X130.A8: rated value +6 V X130 A12 rated value –6 V X130.D12: rated value –12 V	No voltage or considerably low voltage: Remove the respective boards from the instrument one by one and repeat the measurement. If the voltage is supplied, then, the error is probably located on the module removed. ***Note:*** *The power supply switches off all voltages after a short time in case of a short-circuit. Restart by pressing the Standby/On key.*

Error: Fan does not work.

Action	Possible error causes and further steps
Check voltage at connector: X35 pins 1+ 3 : rated value 7 V (depends on temperature)	Voltage o.k.: fan is defective Voltage too low: fan is blocked or power consumption too high

Troubleshooting Problems with Boot-process

- **Error: FSU does not start the measurement application.**

Following switch-on, the FSU first boots the computer BIOS. After successful initialization of the computer the Windows NT operating system starts up. Subsequently, the test application is loaded as start-up program. Simultaneously, selftests are performed at various locations and error messages, if any, are output. The messages are disabled with normal operation, but can be enabled for troubleshooting purposes. It is advisable for troubleshooting to connect a keyboard to the keyboard socket.

Normal action

➢ Start FSU

Subsequent to switching on the FSU, the following BIOS message is displayed:

```
Award Modular BIOS v4.51PG, An Energy Star Ally
Copyright (C) 1984-97, Award Software, Inc.

R&S FSU FMR 5 BIOS V1.0-22-1
        ----------------------------------------
        | Rohde&Schwarz GmbH & Co KG      |
        | Analyzer BIOS V1.0              |
        ----------------------------------------

06/24/99-i430TX-67X-2A59IED4C-00
```

After the first beep, the computer starts the hardware test and the message:

```
, ESC to skip Memory test...
```

is shortly displayed at the lower edge of the screen.

The test results are usually not displayed. If errors occur during the boot procedure, these messages may indicate defects.

➢ The messages can be made visible by pressing the "DISP" key following the beep. The keystroke is acknowledged by a second beep.

Then, all messages are displayed.

```
Award Modular BIOS v4.51PG, An Energy Star Ally
Copyright (C) 1984-97, Award Software, Inc.

R&S FSU FMR 5 BIOS V1.0-22-1
            65536K OK  (= the result of the
memory test is indicated here)
```

Error and error cause

If no result of the memory test is indicated, the memory is defective.

Normal action

Error and error cause

06/24/99-i430TX-67X-2A59IED4C-00

The memory test issues the memory capacity of the front module controller. The basic version of the FSU provides 64 Mbytes. Subsequently, BIOS starts the hardware check and displays all PC boards found.

➢ This procedure may be interrupted using the "BREAK" key on the connected external keyboard, any other key continues the boot process.

If this hard disk entry is missing, the hard disk may be faulty

Award Modular BIOS v4.51PG, An Energy Star Ally
Copyright (C) 1984-97, Award Software, Inc.

R&S FSU FMR 5 BIOS V1.0-22-1
65536K OK

Award Plug and Play BIOS Extension v1.0A
Copyright (C) 1997, Award Software, Inc.
Detecting HDD Primary Master...*IBM-DKLA-24320*
(depends on the hard disk installed)

06/24/99-i430TX-67X-2A59IED4C-00

Then, the SETUP is displayed.

➢ This procedure may also be interrupted using the "BREAK" key.

The contents partly depend on the hardware provided:

System Configurations

CPU Type	: AMD-K6 3 D	Base Memory	: 640K
Co-Prozessor	: Installed	Extended Memory	: 64512K
CPU Clock	: 300	Cache Memory	: 512K

Diskette Drive A	: 1.44M, 3.5 in.	Display Type	: EGA/VGA
Diskette Drive B	: None	Serial Port(s)	: 3F8
Hard Disk Drive C	: LRG ,UDMA 2, 4327MB	Parallel Port(s)	: 3F8
Hard Disk Drive D	: None	EDO DRAM at Row(s)	: None
		SDRAM at Row(s)	: 0 2
		L2 Cache Type	: Pipelined Burst

PCI device listing.....

Bus No.	Device No.	Funct No.	Vendor ID	Device ID	Device Class	IRQ
0	7	1	8086	7111	IDE Controller	14
0	7	2	8086	7112	Serial Bus Controller	NA
0	17	0	5333	8C01	Display Controller	NA
0	17	0	10EE	4013	Unknown PCI Device	11

Normal action	Error and error cause
The PCI hardware test is displayed in the lower half of the screen. All modules found during the test are displayed with their names and PCI device IDs. The Device Class column lists the types of PCI device. The detector board of the FSU is indicated as "Unknown PCI Device".	If the line "Unknown PCI Device" is missing, the detector board was not identified and the measuring application cannot be started. If the remaining PCI devices have all been identified, the detector board will probably contain the error, which is why the board must then be replaced
After this test, the BIOS has been loaded and the operating system is started.	The message "No System Disk or Disk error ..." at this point indicates that the contents of the hard disk are not correct. Replace the hard disk.
After Windows NT was installed correctly, the following selection menu is displayed: **OS Loader V4.00** **Please select the operating system to start:** **Analyzer Firmware** **Analyzer Firmware Backup** **Use ↑ and ↓ to move the highlight to your choice.** **Press Enter to choose.** **Seconds until highlighted choice will be started automatically: 0** **NT Detect V4.0 Checking Hardware ...**	After Windows NT was installed correctly, the following selection menu is displayed:
Approx. 5 sec later, the following message is displayed: **OS Loader V4.01....** **Press spacebar now to to invoke Hardware Profile/Last Known Good menu**	
followed by (blue background): **Microsoft (R) Windows NT (TM) Version 4.0 (Build 1381 : Service pack 5)** **1 System Processor [64 MB Memory]**	
The version numbers depend on the used version	

Normal action

Error and error cause

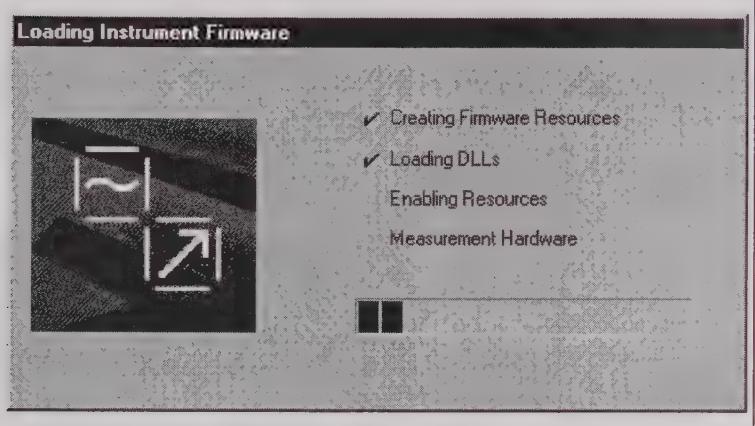
If the operating system on the hard disk has been destroyed and cannot be loaded correctly, Windows NT reacts by a "Bluescreen". This bluescreen contains all essential information on the internal states of the computer which are displayed as follows (by way of example):

DSR CTS
*** STOP: 0x0000000A (0x00000000, 0x0000001a, 0x00000000, 0x00000000)
IRQL_NOT_LESS_OR_EQUAL
p4-0300 irql:1f SYSVER 0xf000030e
Dll Base DateStmp - Name
80100000 2e93fe55 - ntoskrl.exe
80010000 2e4184b - hal154x.sys
8001b000 2e4e7b6b - Scsidisk.sys
fe420000 2e406607 - Floppy.SYS
fe440000 2e406659 - Kb_Rec.SYS
fe460000 2e40652d - Beep.SYS
fe480000 2e42a4a4 - i8042prt.SYS
fe4a0000 2e40660c - Kbdclass.SYS
fe4b0000 2e53d49d - ati.SYS
fe4e0000 2e406655 - Msfs.SYS
fe510000 2e53f222 - NDIS.SYS
fe550000 2e406697 - TDI.SYS
fe560000 2e5279d9 - awlakipx.sys
fe580000 2e494973 - tcpip.sys
fe5b0000 2e5279d3 - netbt.sys
fe5e0000 2e4066b3 - rdp.sys
fe630000 2e53f24a - srv.sys
Dll Base DateStmp - Name
80400000 2e53eba4 - hal.dll
80013000 2e4bc29a - SCSIPORT.SYS
80220000 2e53f238 - Ntfs.sys
fe430000 2e406618 - Scsicdrm.SYS
fe450000 2e40660f - Null.SYS
fe470000 2e406634 - Sermouse.SYS
fe490000 2e40660d - Mouclass.SYS
fe4c0000 2e4065e2 - VIDEOPRT.SYS
fe4d0000 2e4065e8 - vga.sys
fe4f0000 2e414f30 - Npfs.SYS
fe500000 2e4071db - elnkii.sys
fe530000 2e47c740 - abf.sys
fe570000 2e53a89e - awlnkwb.sys
fe5a0000 2e525cb8 - afd.sys
fe5d0000 2e4167f7 - netbios.sys
fe5f0000 2e4f9f51 - rdr.sys
fe660000 2ef16062 - awlnkspx.sys
Address dword dump Build [1057]
FF541E4c fe5105df fe5105df 00000001 ff640120 fe1a8228 000002fe - NDIS.SYS
ff541e60 fe501368 fe501368 00000246 00004002 00000000 00000080 - elnkii.sys
ff541eb4 fe481509 fe481509 ff6688c8 ff668288 00000000 ff668138 - i8042prt.SYS
ff541ee0 fe481ea8 fe481ea8 fe482070 00000000 ff541f04 8013c58a - i8042prt.SYS
ff541ee4 fe482070 fe482070 00000000 ff541f04 8013c58a ff6688c8 - i8042prt.sys
ff541ef0 8013c58a 8013c58a ff6688c8 ff668040 80405900 00000031 - ntoskrnl.exe
ff541ffc 80405900 80405900 00000031 06060606 06060606 06060606 - hal.dll
Restart and set the recovery options in the system control panel
or the /CRASHDEBUG system start option if this message reappears,
contact your system administrator or technical support group.
CRASHDUMP: Initializing miniport driver
CRASHDUMP: Dumping physical memory to disk: 2000
CRASHDUMP: Physical memory dump complete

Windows NT and the instrument firmware must then be updated from the back-up partition (cf. Chapter 4, Section "Initial Setup/ Update of the Instrument Firmware").

Subsequent to starting the operation system, the application for the FSU is loaded in a start-up program. The program start is initiated automatically and generates a window , which displays information on the start-up procedure.

Normal action



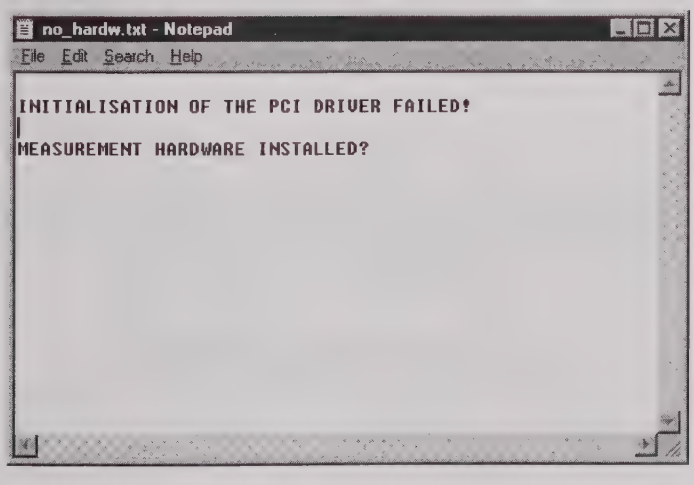
While booting, the detector board is identified again.

Error and error cause

If a "Bluescreen" is displayed with loading, a cold start may be necessary. Proceed as follows in such a case:

- Cold start (keep point key pressed after first beep until display of the selection menu)
- Firmware update from the backup partition, if cold start does not succeed.(see chapter 4)

If the detector board is not identified, the following message is issued:



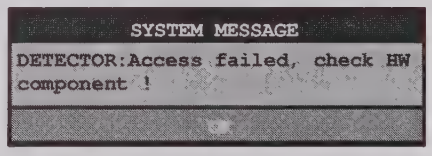
Normal action

When the program has been loaded, the measurement hardware is initialized first. A timer which is controlled by a 32-MHz clock signal is set on the detector board. This test reveals proper functioning of the detector board and the clock oscillator in the FSU (frontend).

After passing the function tests, the analog boards are initialized and the correction data EEPROMs are loaded.

Error and error cause

If an error occurred on the detector board or the clock is missing, the following message is displayed:



➢ In this case, first check the clock generation in the instrument.

The reference is generated on the synthesizer module. The 32 / 128-MHz reference are necessary for the correct operation of the detector board.

The following mesasurements are appropriate to check the reference supply:

Measurement:	**Result:**
Synthesizer , X122: rated value 128 MHz, 0 dBm ⇓	No signal: replace synthesizer
Synthesizer , X123 : rated value 32 MHz, 0 dBm	No signal: replace syntheszer.

If no error occurs with the clock generation, booting can be continued by acknowledging the error message entering "OK"

If no error message or any other information on the error source was issued with booting, the error can only be determined by replacement of the detector board or the front-module controller.

Troubleshooting - Loading Module EEPROMs

- **Error: Data of modules cannot be read.**

Normal action	Error and error cause
On booting the instrument all calibration data required must be written into the RAM of the computer. The calibration data of a module are either read from the EEPROM (in case of a cold start from EEPROM only) or from the associated binary file. For each module identified by the software it is checked first the EEPROM can be read.	
If reading at the desired address is not possible, the software assumes that the module is not available.	For modules that must always be available (eg IF filter) an error message will be output: Error reading EEPROM of IF Filter
The calibration data are then read from the file pertaining to the module (eg iffilt.bin).	If error-free reading of the binary file is not possible either, an error message is output again. Error reading file of IF Filter
If reading at the address of an optional module is not possible, this module is marked as not available in the module array for storage of the module information. If the file pertaining to the non-available module does exist, it is assumed that upon the last successful booting the module was available but has been removed meanwhile. The file with the calibration data of the module is erased. Moreover the data collected during the last calibration are invalid and only saved as a backup copy on the hard disk	
	If reading at the address of a module is possible but the contents of the data block faulty (eg check sum of header block incorrect), the calibration data of the respective module are read from the associated file. The firmware assumes that the module is available. Error reading EEPROM of IF Filter

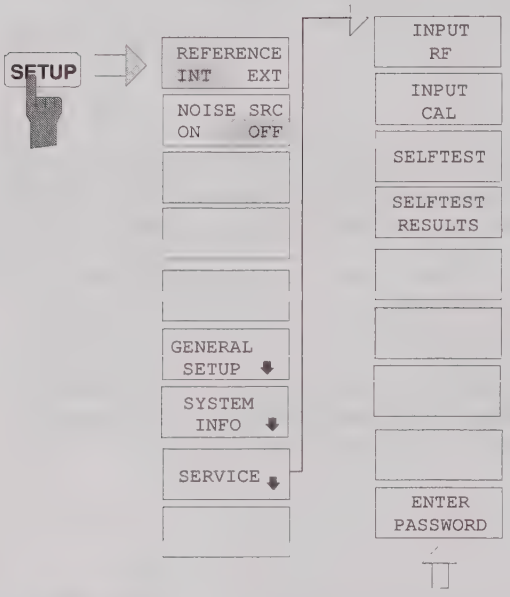
Normal action	Error and error cause
Upon successful reading of the module header from the EEPROM the contents of the module header is entered into the array for storing the module information. The module header read from the EEPROM is compared with the module header of the associated binary file. If the module header can be read from the file and agrees with the header read from the EEPROM it is assumed that the contents of the module EEPROM has already been mapped in the binary file. The calibration data can thus be written from the file to the RAM.	If however the associated file cannot be found or if the module header of the EEPROM differs from that of the file, the total EEPROM contents must be written to the RAM and then saved in the binary file. Error finding file of IF Filter
After loading the calibration data from the EEPROMs, the calibration data are loaded from the calibration data files (eg DDC settings for various filters). First the relevant calibration data file is written to the calibration data memory.	If an error occurs upon loading the file into the memory, an error message is output: Error reading file of DDC Filter
Upon successful loading of the calibration data file the latter is compared with its backup copy on the hard disk.	
After loading the calibration data from the EEPROMs and files, the data collected during the last calibration are loaded from the 'rdf_cal.bin' file into the calibration data memory. This process takes only place if valid calibration data (and the 'rdf_cal.bin' file) are available.	If there are no valid calibration data, the status message "UNCAL " is output informing the user that the instrument is uncalibrated.

Troubleshooting via Selftest

The selftest is provided for identification of instrument errors and tolerance violations which can not be corrected with self-alignment of the instrument.
All signal paths are connected and the signal is traced via test points. The selftest checks all possible hardware settings which are used for the self-calibration with regard to sufficient setting range including reserves.

Service Level 1 - Test after Entry of the Password
When entering the password, the test result is recorded in detail and in case of a fatal error (such as a failure of the operating voltage), the selftest is *not* aborted..

All operating functions required in connection with the selftest are offered in the *SETUP - SERVICE* menu:



➢ Enter the password 894129 for service le

➢ Initiate the selftest of the instrument modules using the *SELFTEST* softkey

While the selftest is running, a message box is displayed, which shows the current test and test result.

➢ .....Pressing ENTER ABO

All modules are tested one by one and the test result (selftest PASSED or FAILED) is output in the message box

The *SELFTEST RESULTS* softkey calls a complete list of all test results.
If an error occurs, a brief description of the failed test, the module concerned, the valid range and the measurement value are displayed.

```
Total Selftest Status: ***FAILED***
Date (dd/mm/yyyy): 10/06/1999 Time: 16:34:47
Runtime: 05:59

Supply voltages detector
test description     min          max          result     state
+6V                    5.88         6.42         6.06     PASSED
+8V                    7.84         8.96         8.56     PASSED
+12V                  11.76        12.83        12.42     PASSED
-12V                 -11.33       -13.28       -11.85     PASSED
+28V                   26.62        29.39        28.34     PASSED
```

Selftest design and Error Messages

Overview

The calibration source on the synthesizer module is used as signal source for testing the signal path.

1. Measurement of the operating voltages of the power supply and the regulated operating voltages on the analog modules
2. Temperature measurement on the analog boards
3. Testing the fourfold D/A converter on the detector
4. Test of the synthesizer module
5. Test of the 1st local oscillator and test of the lo level´s on the RF converter module
6. Testing of the signal-path via RF converter, IF filter and detector board
7. Test of optional modules

All measurements on the analog boards are independent of the gate arrays on the detector board, since individual A/D converters are provided for them on the analog boards. The interface section in the FPGA of the detector board must function properly to read these A/D converters. This is always tested with switching on the instrument.
The signal path via the gate arrays on the detector board is tested using a known, analog signal at the input of the A/D converter on the detector board. The analog test signal is provided by the preceding analog tests.
Since the operating voltages are measured first, it is ensured that the selftest can be performed correctly. If an operating voltage failed which is not required by the selftest this is correctly signaled in the error list. If, however, all operating voltages are indicated to be faulty, it may well be assumed that the operating voltage for the selftest has failed or the selftest A/D-converter itself is defective.

Operating Voltages

When an operating voltage fails, the selftest is aborted to avoid subsequent error.
The test is not aborted under service level 1. All subsequent errors are then listed in the result record. Errors which occurred independent of the voltage failure can then be detected, still.
The error message indicates the error source (f.e. power supply, IF filter, detector board) and the voltage which failed.

Normal action	Error and error cause
Power Supply The voltages of the power supply and the –6 V regulator (dc-dc converter from –12 V to –6 V on the motherboard) are measured at the board connector by means of the selftest A/D-converter on the detector board.	
Channel 1: +6V Channel 2: +8V Channel 3: +12V Channel 4: -12V Channel 5: +28V Channel 7: -6V	FATAL ERROR! Power supply: DC FAIL +6V. Selftest aborted.
	➢ If error messages occur, the voltages on the motherboard should be checked. The tolerances given in the column "Tolerance range power supply / voltage regulator" apply in this case. If the voltages adhere to the tolerance limits, the error must be located in the selftest:
	➢ Replace the detector board.
Regulated Voltages on the Boards **Detector Board**	
Channel 6: -5V	FATAL ERROR! Detector: DC FAIL -5V. Selftest aborted.
	➢ If the preceding tests passed, the detector board has to be replaced.

Temperature Measurement on IF-Filter

Normal action	Error and error cause
The **temperature** is measured, first. If the temperature violates the permitted range from 0° to 70°C, the following warning is output:	WARNING! IF-FILTER: Operating Temperature xx °C - out of range
	➢ Check the temperature data to plausibility. The fan might be defective or the ventilation slots might be covered. If the temperature data indicated are not reasonable, e.g., if the temperature of the instrument is indicated to be 120° C, the temperature sensor or the selftest may be faulty. If , in the following, the *first* operating voltage (or all operating voltages under service level 1) is measured incorrectly, the selftest will obviously be defective.

Channel	Nominal voltage	Designation, name which occurs in the error message
74	- 5 V	UREF-5
77	+2,5 V	UREF+2.5
76	+3,3 V	+3.3V
73	+5 V	+5V
72	+10,6 V	+10V
71	-5 V	-5V
70	-10,6 V	-10V
75	+5 V	+5VR

➢ The IF filter board must be replaced in any case, if an error message occurs which refers to these operating voltages or the temperature (if not plausible).
The voltage of the temperature sensor is used for temperature compensation of the filters. Thus, a faulty temperature sensor may detune the filters such that subsequent errors are likely to occur.

Checking the 4-fold D/A-converter on the detector board.

Normal action	Error and error cause

Detector Board Pretune-DAC Test
The 4-fold D/A-converter on the detector board is checked.
One D/A converter controls the frequency-dependant IF gain on the IF filter for frequency response correction. The other ones are provided for options (microwave converter, tracking generator).
The first output voltage of the 4-fold D/A converter is measured, thus checking the basic function of the control interface (in DCON gate array), also.

Channel	Nominal voltage
8	666 mV

FATAL ERROR!
Detector: Pretune DAC FAIL – check DCON and pretune DAC
Selftest aborted.

➢ Replace the detector board

Testing of the Synthesizer Module

Normal action	Error and error cause

Channel	Nominal voltage	Designation, name which occurs in the error message
11	- 5 V	-5 V
01	+5 V	+5 V
21	+7 V	+7 V
60	+12 V	+12 V
41	+28 V	+28 V

➢ The synthesizer board must be replaced in any case, if an error message occurs which refers to these operating voltages .

Temperature Measurement:
There are two temperature sensors on the synthesizer board, one for the temperature of the module and one for the temperature of the oven of the 128 MHz reference oscillator.

10 MHZ Output level:
Channel 71

Warning!
Synthesizer: Temperature out of range

Channel 51

Warning!
Synthesizer: Temperature 128 MHz reference out of range

➢ With low temperature at the reference oscillator the reference oscillator might be unlocked, due to it´s temperature drift.

➢ Replace synthesizer board

Normal action	Error and error cause

Reference signals on the synthesizer board:
The phase locked loops on the synthesizer board are checked if they are locked and within their allowed tuning range.

10 MHz OCXO level:
level detector channel 00

FATAL ERROR!
10 MHz OCXO defect !

Replace Synthesizer !

128 / 384 MHz Oszillators:
Test of the 128 MHz XTAL oscillator and of the 3rd Local

ERROR!
Reference 128 MHz / 3rd LO unlocked !
or:
Reference 128 MHz / 3rd LO out of tuning range

The FSU might work ok, but the tuning voltages are close to their limits, or the frequency accuracy might be out of tolerance.

➢ Replace the Synthesizer board !

Sweep-Synthesizer: Test of the tuning voltage of the Sweep VCO 600 (595) – 620 MHz.	ERROR! Sweep Synthesizer unlocked ! or: Sweep Synthesizer out of tuning range Additionally the YIG oscillator might be unlocked as it´s reference is missing or wrong in frequency. ➢ Replace the Synthesizer board !
2nd Local Oscillator: Test of the control voltage of the 2nd Local	ERROR! 2nd LO tuning voltage out of range Additionally the YIG oscillator might be unlocked as it´s reference is missing or wrong in frequency. ➢ Replace the Synthesizer board !
Control voltage of calibration signal: Test of the detector voltage in the level control of the calibration signal.	ERROR! Calibration signal error As soon as the control voltage violates the tolerance, the level control loop unlocks and the level becomes inaccurate. If the level error is small, the selftest of the signal path can be performed. However, following the calibration of the instrument, the level measuring accuracy will be out of tolerance. ➢ Replace synthesizer board !

Testing of the RF Converter Module

Normal action	Error and error cause

Channel	Nominal voltage	Designation, name which occurs in the error message
60	+ 5 V	+ 5 V
61	-5 V	- 5V
62	+7 V	+7 V
63	+11 V	+11 V
64	+28 V	+28 V

➢ The RF converter board must be replaced in any case, if an error message occurs which refers to these operating voltages .

Measurement of board temperature:
Channel 67

Warning!
RF Converter: Temperature out of range

➢ Check if the fan works ok !

➢ Replace RF converter !

Test of Local Oscillator level´s:
The level detectors of the 2nd and 3rd local oscillators are tested.

Channel	Signal	Error Message
3	2nd LO	Level 2nd Local
2	3rd LO	Level 3rd Local

➢ If error message occurs check the signal level at the following inputs of the module RF converter. Setting FSU: Preset, Center 128 MHz, Zero Span.

➢ + 10 dBm / 384 MHz at X101

➢ + 7 dBm / 4224 MHz at X105

If the signals are within +-3dB level error then replace RF converter. If the signals are low check the cables from the synthesizer and replace synthesizer or the defective cable !

Test 1st Mixer

Both mixer diodes rectify a part of the LO power. This two voltages can be checked via the selftest.

Are both voltages low, the LO level might be low, therefore the error message:

FATAL ERROR!
1st LO level low or 1st mixer defective !

If the two voltages are more than 20 % different, then one diode might be defect.

FATAL ERROR!
1st mixer symmetry out of tolerance !
Selftest aborted.

➢ Replace RF converter in both cases !

Test of the Signal Path on the RF Converter Board

Normal action | **Error and error cause**

Signal Path over RF Attenuator

The following attenuator settings are tested with the 0 dBm test signal at 128 MHz. It is measured via a logarithmic detector on the 2nd IF of the RF converter.

Rf-Att	Coupling	Levelcheck
0 dB	DC	0 +- 5 dBm
0 dB	AC	0 +- 5 dBm
5 dB	DC	-5 +- 5dBm
10 dB	DC	-10 +- 5 dBm
20 dB	DC	-20 +- 5 dBm
40 dB	DC	-40 +- 10 dBm

If **no** setting is in tolerance, the error message is:

FATAL ERROR!
Input Level RF converter out of tolerance

➢ Check the input signal of the RF converter with Cal signal 0dBm, input attenuator 0 dB and DC coupling. The signal should be at 128 MHz with 0 dBm. If the level is more than 3 dB inaccurate, check the signal also directly at X125 of the synthesizer.

➢ If signal ok, then replace RF converter !

➢ If signal not within the tolerance at the output of the synthesizer replace the synthesizer

➢ If only few measurements out of tolerance or the signal is present at the input, but not at the output of the RF attenuator, the RF attenuator is defective:

If minimum one setting is in tolerance, the error message is:

FATAL ERROR!
RF Attenuator XX pad failed !

➢ Replace RF attenuator !

Signal Path on the IF Filter Board

The RF attenuator is used to provide an appropriate test level. Therefore, a fault in the RF attenuator will entail subsequent errors with the IF filter test.

Normal action	Error and error cause
Input Level of IF Filter / Calibration Amplifier (CAL-Amps 1 + 2)	FATAL ERROR! IF Board: IF input level / CALAMP Selftest aborted Possible error causes: • Signal path interrupted in the RF converter • Erroneous EEPROM data in the RF converter leading to incorrect setting of CAL_Amp1. • CAL_Amp1 or 2 faulty. Troubleshooting ➢ Check the level applied at X132 with, Cal Source 0 dBm, Center 128 MHz, RF attenuation 0 dB. Level = -3 +- 4 dBm, frequency 20.4 MHz ➢ Replace the RF converter, if the deviation exceeds this value

Normal action	Error and error cause
	If the level adheres to the tolerance, a defective CAL_Amp may have caused the error. The setting ranges of the CAL_Amps are tested during the selftest, later. The selftest passes under service level 1. ➢ Note, whether the result file contains any error messages concerning the CAL_Amps. If no CAL_Amp error occurred, the CAL_Amps will be set incorrectly. The EEPROM data in the frontend are obviously incorrect (cf. troubleshooting instructions for the frontend)
LC-Filter I and XTAL Filter **Selftest detector B (see block diagram)** The level measurement is performed with wide and narrow bandwidths of the LC filter. Subsequently, it is additionally measured via the crystal filter. If the LC filter does not work properly, the measurement of the crystal filter is not performed.	ERROR! IF Board: LC Filter-1/2 wide XTAL Filter not tested ERROR! IF Board: LC Filter-1/2 narrow XTAL Filter not tested ERROR! IF Board: XTAL Filter ➢ The IF filter board must be replaced in all cases.

Normal action	Error and error cause
StepGain (IF Amplifier) **Selftest detector C (see block diagram)** The 10-dB Step Gain (Step Gain Coarse) and the 0.1 dB Step Gain (Step Gain Fine) are tested. The input level is attenuated in steps of 10 dB by the RF attenuator and amplified by means of the StepGain by the same amount, simultaneously. The level detector C checks to ±6 dB (user) or ±4 dB (service level 1).	FATAL ERROR! IF Board: Step Gain Fine Selftest aborted ➢ Replace the IF-filter board. ERROR! IF Board: Step Gain Coarse ➢ Testing the amplifier stages. ERROR! IF Board: Step Gain Fine ➢ Testing the amplifier stages. ***Attention:*** *If the RF attenuator test caused output of an error message, Step Gain cannot be tested and an error message must be ignored* ➢ If the RF attenuator test passed without any error, Step Gain is defective. ➢ Replace the IF-filter board. However, the selftest can be continued, since it does not require the IF gain.

Normal action	Error and error cause
Test of detector board: Several settings of the detector board are tested via the normal functions on the display. The three modes are FFT, digital bandwidth and analog bandwidth. The possible errors are:	FATAL ERROR! Detecttor Board: FFT failed Selftest aborted FATAL ERROR! Detecttor Board: FIR filter failed Selftest aborted FATAL ERROR! Detecttor Board: Video failed Selftest aborted

Troubleshooting RF Converter

Depending on the kind of error a few measurements should be performed on the frontend prior to replacing the module:

- **IP3 too high**
- **Signal level too low**
- **LO feedthrough too high**
- **Spurious signals**

Depending on the kind of error a few measurements should be performed on the RF converter prior to replacing the module.
Very high values with input frequency 0, > -10dBm with an input attenuation of 0 dB indicate that the mixer does not work properly.

Action	Error and error cause
Measure with diode tester at X108: rated value: 0.6 V voltage in the forward and reverse directions with a current of 1 mA.	Different values in both directions, high-impedance or very low-impedance: mixer defective : replace RF converter

- **Signal missing or displayed with incorrect frequency**

If the signal is missing or the instrument signals "LOUNL", the conditioning of the 1st LO is probably not correct. The function of this oscillator requires both, the EEPROM data and the reference frequency of the second module.

Action	Error and error cause
Measure function of the 1st LO in zero span. check signal at X107: rated value: 4628.4 MHz above the current input frequency (between 0Hz and 3.6 GHz) and the signal level is approx. + 5dBm.	The frequency is considerably higher or lower or ithe signal is not stable RF converter defective replace RF converter

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4 Software Update / Installing Options

This chapter contains information on Software-Update and Installing Options to the FSU. Additional manuals obtained together with a software/firmware update or with subsequently acquired options can be filed here.

Installation of new FSU Software

The installation of a new firmware version can be performed using the built-in diskette drive. The firmware update kit contains several diskettes.
The installation program is called up in the *SETUP* menu.

SETUP sidemenu:

The *FIRMWARE UPDATE* softkey starts the installation program and leads the user through the remaining steps of the update

IE/IEEE-bus command: --

Performing the update:

Insert diskette 1 into the drive.
Call *SETUP* side menu *[**SETUP**][**NEXT**]*

Start update *[FIRMWARE UPDATE]*

The *RESTORE FIRMWARE* softkey restores the previous firmware version

IEC/IEEE-bus command: --

Installing the Options

The following options are available with the FSU:

Option OCXO	FSU-B4	1144.9000.02
Option External Generator Control	FSP-B10	1129.7246.02
Option LAN Karte	FSU-B16	1144.9498.02
Option Elektronic Attenuator	FSU-B25	1144.9298.02

For retrofitting, please note the mounting instructions enclosed with the options.
These mounting instructions can be filed at this place in the service manual and are thus easily available whenever they are required.

Caution!

Disconnect the instrument from the mains before opening the casing. Also note the safety instructions at the beginning of this manual.

The components used in the instrument are sensitive to electrostatic discharges which is why they are to be dealt with according to the ESD regulations.

When installing hardware options note the following:

- Switch off instrument and pull the mains plug.
- Unscrew the 4 rear-panel feet (450) and push the tube (410) backwards and take off.
- After installing the option replace the tube and fasten the rear panel feet again.

Caution!

When replacing the tube take care not to damage or pull off cables.

- Switch on FSU.
- Install additional software, if supplied, according to the instructions enclosed with the option.
- If an adjustment is required for this option, the appropriate hints are to be found in the installation instructions for the option.

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5 Documents

This chapter provides information on the ordering of spare parts and contains the spare part list and the documents for the complete FSU unit.

Shipping of Instrument and Ordering of Spare Parts

Please contact your Rohde & Schwarz support center or our spare parts express service if you need service or repair of your equipment or to order spare parts and modules.

The list of the Rohde & Schwarz representatives and the address of our spare parts express service are provided at the beginning of this service manual.

We require the following information in order to answer your inquiry fast and correctly and to decide whether the warranty still applies for your instrument:

- Instrument model
- Serial number
- Firmware version
- Detailed error description in case of repair
- Contact partner for checkbacks

Shipping of Instrument

When shipping the instrument, be careful to provide for sufficient mechanical and antistatic protection

➢ Repack the instrument as it was originally packed when transporting or shipping. The two protective caps for the front and rear panels prevent the control elements and connectors from being damaged. The antistatic packing foil avoids any undesired electrostatic charging to occur.

➢ If you do not use the original packaging, provide for sufficient padding to prevent the instrument from slipping inside the package. Wrap antistatic packing foil around the instrument to protect it from electrostatic charging.

Shipping of a Module

When shipping a module, then, also be also careful to provide for sufficient mechanical and antistatical protection

➢ Ship the module in a sturdy, padded box.

➢ Wrap the board into antistatic foil.
If the packaging is only antistatic but not conductive, additional conductive packaging is required. The additional packaging is not required if the enclosed packaging is conductive.
Exception: If the module contains a battery, the tightly fitting packaging must always consist of antistatic, non-chargeable material to protect the battery from being discharged.

Ordering Spare Parts

To deliver replacement parts promptly and correctly we need the following indications:

- Stock number (see component lists in this chapter)
- Designation
- Component number according to component list
- Number of pieces
- Instrument type the replacement part belongs to
- Contact person for possible questions

The stock numbers necessary for ordering replacement parts and modules as well as power cables can be found further down.

Refurbished Modules

Refurbished modules are an economic alternative for original modules. It should be kept in mind that refurbished modules are not new, but repaired and fully tested parts. They may have traces from use but they are electrically and mechanically equivalent to new modules.

To find out which refurbished modules are available, please refer to your Rohde & Schwarz representative (or to the central service division, Rohde & Schwarz Munich).

Taking back Defective Replaced Modules

Defective modules of the replacement program which can be repaired are taken back within **3 months** after delivery of the replaced module. A repurchasing value is credited.

Excluded are parts which can not be repaired, e.g. PCBs that are burnt, broken or damaged by repair attempts, incomplete modules, parts which are heavily damaged mechanically.

The defective parts must be sent back with a **returned accompanying document** containing the following information:

- Stock number, serial number and designation of the dismounted part,
- **Precise** description of the error,
- Stock number, serial number and designation of the instrument the part was dismounted from,
- Date of dismounting,
- Name of the technician who exchanged the part.

A returned accompanying document is provided with each replacement module.

Spare Parts

The stock numbers necessary for ordering replacement parts and modules can be found in the component lists further down.

Important Note!

When replacing a module please note the safety instructions and the repair instructions given in chapter 3 and at the beginning of this service manual

When shipping a module be careful to provide for sufficient mechanical and antistatical protection.

Available Power Cables

Table 5-1 List of power cables available

Stock No.	Earthed-contact connector	Preferably used in
DS 006.7013	BS1363: 1967' complying with IEC 83: 1975 standard B2	Great Britain
DS 006.7020	Type 12 complying with SEV-regulation 1011.1059, standard sheet S 24 507	Switzerland
DS 006.7036	Type 498/13 complying with US-regulation UL 498, or with IEC 83	USA/Canada
DS 006.7107	Type SAA3 10 A, 250 V, complying with AS C112-1964 Ap.	Australia
DS 0025.2365 DS 0099.1456	DIN 49 441, 10 A, 250 V, angular DIN 49 441, 10 A, 250 V, straight	Europe (except Switzerland)

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Spare Part List

Mechanical Drawings

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List of FSU parts including spare parts

The FSU is constructed in accordance with R&S design 2000.

Overall dimension: W x H x L, 372,75 x 176,50 x 395,00

Rackmount: 4E 7/8 T350

Accessories: 19"-Adapter ZZA-411, Stock no. 1096.3283.00

Note: *The recommended spare parts are marked x in the like column.*

Table 5-2 List of all FSU part and spare parts

Position	Designation	Stock No.	Number	Electrical designation	Recommended Spare Parts
Document 1129.9032.00 (FSU-Basic unit)					
10	Basic Unit	1129.9032.00	1 S		
15	Fan	1091.1001.00	1 S	E1	x
17	Speaker	1129.9332.00	1 S	B1	x
20	Attenuator.(6-STUFIG)	1137.0599.02	1 S	A40	x
40	DIN6900-M2,5X6 -A2	0071.5040.00	2 S		
43	VOL/PHONES BOARD	1093.7094.02	1 S	A191	x
44	Retaining bracket AF-OUT	1129.9326.00	1 S		
45	DIN6900-M2,5X6 -A2	0071.5040.00	1 S		
46	DIN965-M2,5X6-A4-PA	0852.3614.00	2 S		
47	Rotary knob 9,5ACHS-RD4T-GR	0852.1111.00	1 S		
50	KEY-PROBE	1130.2996.02	1S	A80	x
55	DIN965-M2,5X6-A4-PA	0852.3614.00	4 S		
60	Subassembly plate	1129.9255.00	1 S		
70	DIN965-M2,5X6-A4-PA	0852.3614.00	4 S		
80	Adhesive foil 30X20 SW	1093.9051.00	4 S		
90	Cover RD15,9	0009.9200.00	1 S		
100	RF CONVERTER	1130.1990.02	1 S	A100	x
105	SYNTHESIZER	1130.2096.02	1 S	A110	x
110	DETECTOR BOARD 1	1130.2196.04	1 S	A140	x

Position	Designation	Stock No.	Number	Electrical designation	Recommended Spare Parts
120	IF-FILTER	1130.2296.02	1 S	A130	x
130	CONVERTER UNIT(8 GHZ)	1130.2396.02	1 S	A160	x
135	Angle bracket MW converter	1129.9384.00	1 S		
136	DIN965-M2,5X6-A4-PA	0852.3614.00	2 S		
160	Air cover	1129.9355.00	3 S		
170	Rear panel	1129.9149.00	1 S		
180	DIN6900-M2,5X6 -A2	0071.5040.00	6 S		
190	Cover 9-pin SUB-D	1093.8990.00	1 S		
200	Cover 25-pin SUB-D	1093.9000.00	2 S		
210	Cover RD11,1/9,9	0009.9217.00	5 S		
220	Cover f. LAN-connector	0852.0467.00	3 S		
225	Cover f. IEC-BUS	0852.0450.00	1 S		
240	Instrument top cover	1129.9261.00	1 S		
250	DIN6900-M2,5X6 -A2	0071.5040.00	3 S		
260	DIN965-M2,5X6-A4-PA	0852.3614.00	10 S		
270	Printed front panel 3.6GHz	1129.9203.00	1 S		
280	Printed front panel 8GHZ	1129.9210.00	1 S		
295	RF-cable W1 8GHZ	1129.9503.00	1 S	W1	x
330	Assembly plate	1093.4750.00	1 S		
350	DIN965-M2,5X6-A4-PA	0852.3614.0	4 S		
410	BW2-TUBUS 4E1/1T450 EMU	1129.9410.00	1 S		
420	BW 2 - front handle 4U	1096.1480.00	2 S		
430	Screen. M4X14	1096.4909.00	4 S		
440	BW2-instrument foot	1096.2506.00	4 S		
445	BW2-lateral handle.T450	1096.2670.00	2 S		
450	BW2-rear panel foot 50MM	1096.2493.00	4 S		
455	BW2-foil f. rear panel foot	1096.2435.00	1 S		

Position	Designation	Stock No.	Number	Electrical designation	Recommended Spare Parts
Documnet 1129.9032.00 (Grundeinheit FSU)					
500	Instrument frame	1129.9090.00	1 S		
510	MOTHERBOARD	1130.1960.02	1 S	A10	x
520	DIN6900-M2,5X6 -A2	0071.5040.00	7 S		
530	Locking bolt M3	0009.6501.00	4 S		
540	Locking bolt H=4,5-40	1093.9180.00	2 S		
550	Power supply unit 230W	1091.2320.00	1 S	A20	x
560	DIN6900-M2,5X6 -A2	0071.5040.00	10 S		
570	FMR 5+ VARIANTE	1091.2789.00	1 S	A90	x
580	AWARD BIOS ZU FMR5	1093.5327.00	1 S		
590	DIN6900-M2,5X6 -A2	0071.5040.00	10 S		
600	Display unit	1093.4708.03	1 S		
610	DIN965-M2,5X6-A4-PA	0852.3614.00	4 S		
620	Keyboard frame	1093.5127.00	1 S		
630	Keyboard mat	1093.5133.00	1 S	A16	x
640	Keyboard membrane	1093.5140.00	1 S	A15	x
650	Rotary knob RD28 ACHS-RD6	0852.1086.00	1 S		
660	DIN965-M2X6-A4-PA	0852.3520.00	10 S		
670	3,5" FLOPPY DRIVE STD.	0048.4935.00	1 S	A30	x
680	Floppy bracket	129.9161.00	1 S		
690	W300 FLOPPY DATA	1129.9726.00	1 S	W300	
691	FLOPPY POWER	1129.9732.00	1 S	W301	
700	DIN6900-M2,5X6 -A2	0071.5040.00	3 S		
702	DIN6900-M3,0X6 -A2	0071.6847.00	3 S		
710	Harddisk with firmware	1130.1948.00.	1 S	A60	x
720	Ribbon cable	1093.5156.00	1 S	W29	
730	Disk bracket	1093.4837.00	1 S		
740	DIN965-M2,5X6-A4-PA	0852.3614.00	2 S		
750	DIN965-M3X5-A4-PA	0396.8023.00	4 S		

Position	Designation	Stock No.	Number	Electrical designation	Recommended Spare Parts
775	3,4V LITHIUM-BATTERIE	0565.1687.00	1 S		
Documnet 1093.4708.01 Blatt 2 (Display unit)					
805	Assembly tray	1129.9426.00	1 S		
810	Shielded filter plate	1091.2014.00	1 S		x
820	RF spring (177)	1069.3011.00	2 S		
830	RF spring (137)	1069.3105.00	2 S		
840	Plate holder	0852.0844.00	4 S		
850	DIN965-M2X4-A4-PA	0852.3508.00	4 S		
865	Dust sealing	1129.9449.00	1 S		
871	VNR-08C351-INVERTER	0048.8760.00	1 S	T10	x
880	DIN7985-M2X10-A4-PA	0396.8175.00	2 S		
890	DIN125-A2,2-HP	0049.7396.00	2 S		
892	DIN6900-M2,5X6 -A2	0071.5040.00	2 S		
905	Converter cable L=350	1091.2589.00	1 S	W100	x
910	Spin wheel	0852.1170.00	1 S	B10	x
921	800X600X3 TFT DISPLAY	0048.8599.00	1 S	A70	x
930	DIN6900-M2,5X6 -A2	0071.5040.00	4 S		
932	Space	1129.9432.00	4 S		
934	DIN965-M2,5X5-A4-PA	0852.3608.00	4 S		
945	Display connector	1091.2595.00	1 S	W70	x
946	Name plate for display cable	1129.9703.00	1 S		
950	DIN6900-M2,5X6 -A2	0071.5040.00	2 S		
Documnet 1144.9017.00 (Option FSU-B4 1144.9000.02)					
1100	OCXO	1093.7871.03	1 S	A200	x
1120	RF-cable W21	1129.9926.00	1 S	W21	
Documnet 1129.7298.00 Page 2 (Option FSP-B10 1129.7246.02)					
1600	EXT. GEN. CONTROL	1093.8590.02	1 S	A210	x
1610	IEC-BUS Cable W21	1129.7252.00	1 S	W21	x
1612	DIN125-A3,2-A4	0082.4670.00	2 S		

Position	Designation	Stock No.	Number	Electrical designation	Recommended Spare Parts
1614	DIN137-A3-A2	0005.0296.00	2 S		
1620	Aux control cable W22	1129.7269.00	1 S	W22	x
1622	Locking bolt M3	0009.6501.00	2 S		
1624	DIN137-A3-A2	0005.0296.00	2 S		
1626	DIN934-M3-A4	0016.4398.00	2 S		
Documnet 1129.7298.00 (Option FSU-B16 1144.9498.02)					
1240	LAN- Interface COMPACT-PCI	1093.9080.00	1 S	A220	x
1250	Cable 2XRJ45 ST/ST 8P	1130.0935.00	1 S	W32	
1260	Cable-Feedthrough 10X17X6,8	0099.1433.00	2 S		
1270	Adapter 8P.GER	1093.9122.00	1 S	X220	x

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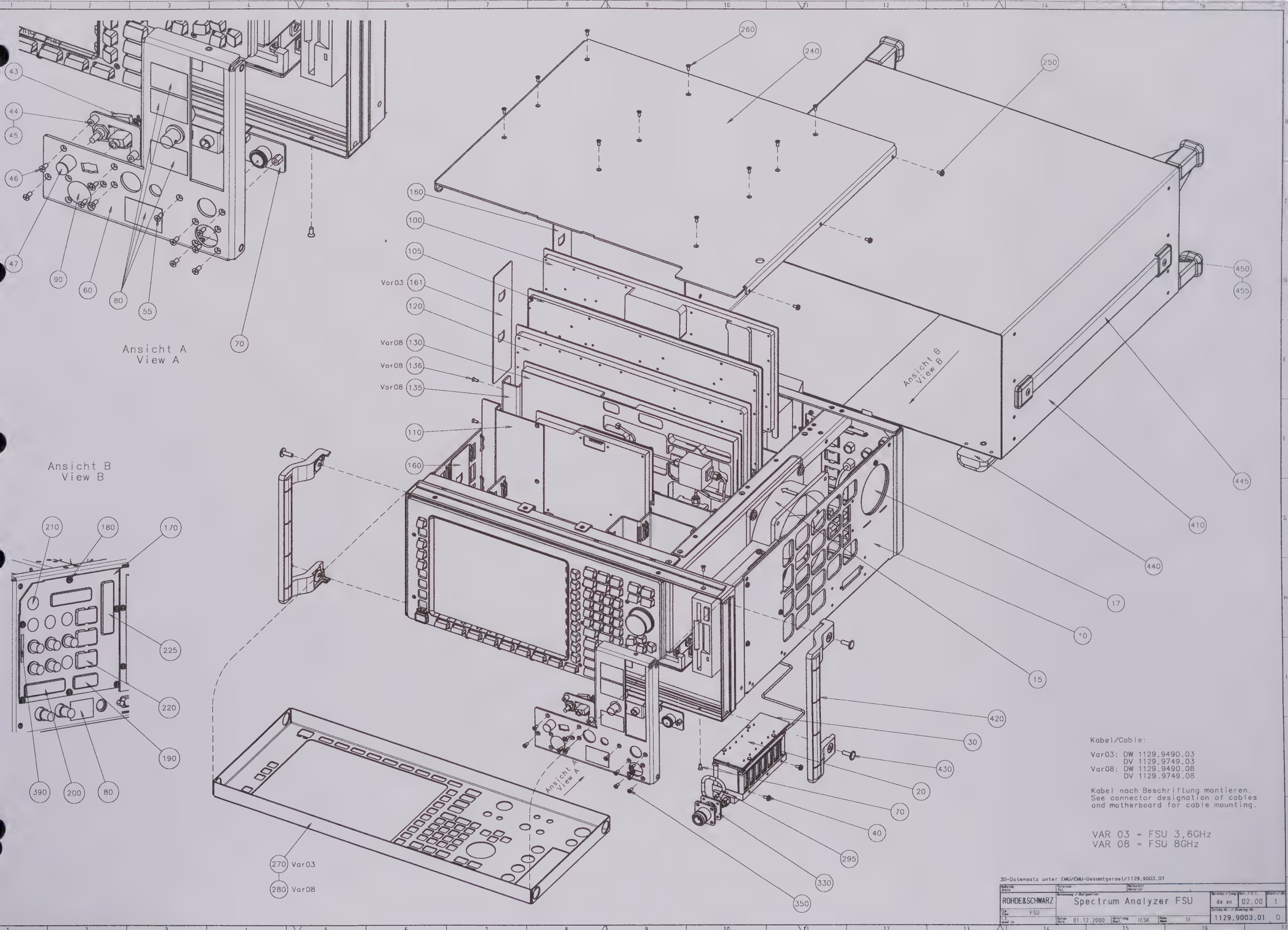
Ansicht A
View A
Ansicht B
View B
Ansicht B
View B
Ansicht A
View A
Var03
Var08
Var08
Var08
Var03
Var08
Kabel/Cable:
Var03: DW 1129.9490.03
DV 1129.9749.03
Var08: DW 1129.9490.08
DV 1129.9749.08
Kabel nach Beschriftung montieren.
See connector designation of cables
and motherboard for cable mounting.
VAR 03 = FSU 3,6GHz
VAR 08 = FSU 8GHz
3D-Datensatz unter EMU/EMU-Gesamtgeraet/1129.9003.01
ROHDE&SCHWARZ
Spectrum Analyzer FSU
FSU
de en
02.00
1
01.12.2000
IESK
TF
1129.9003.01
D

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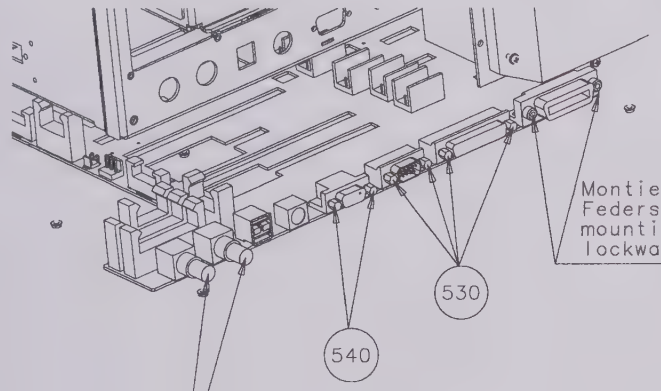

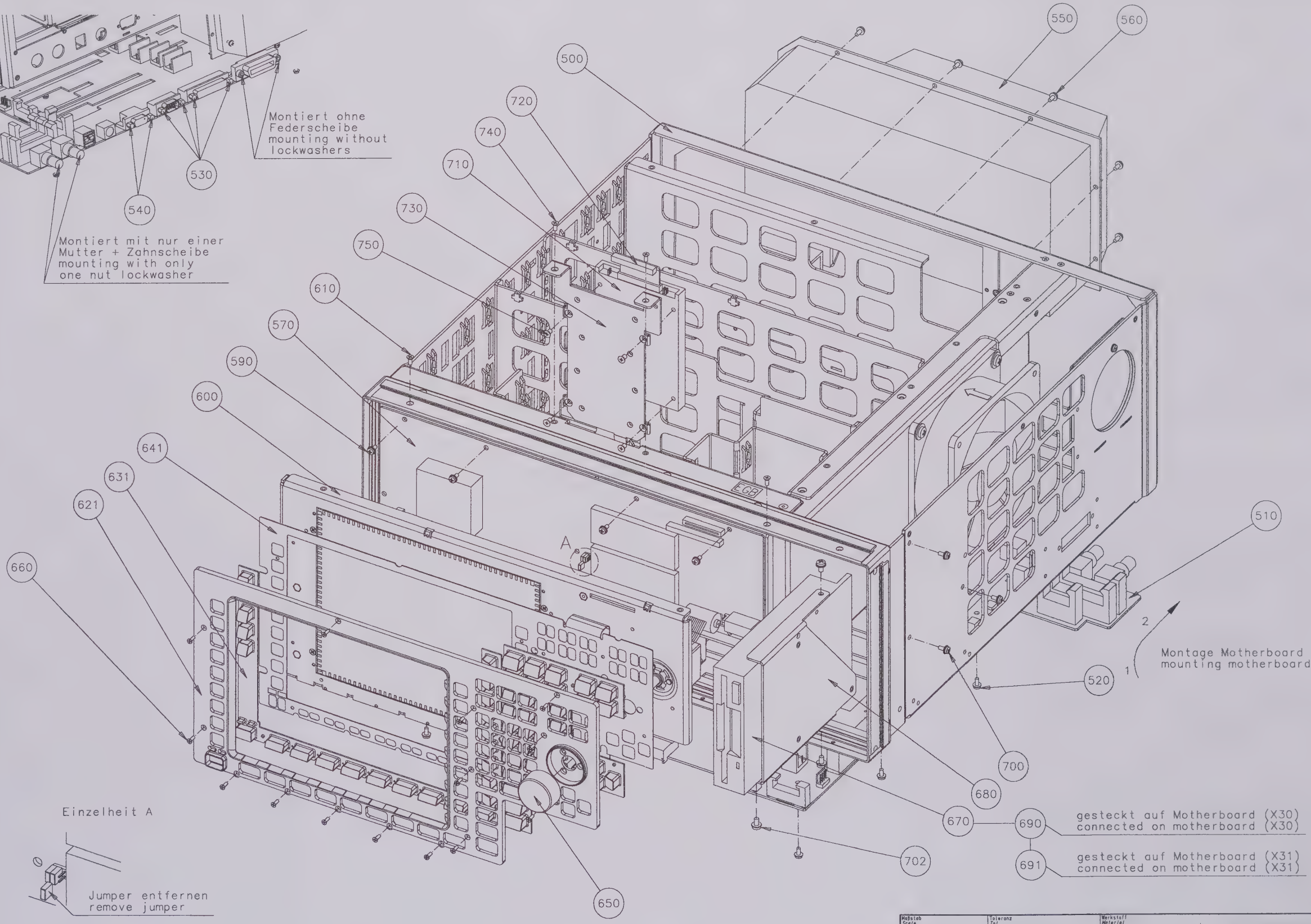

Einzelheit A

Maßstab / Scale	Toleranz / Tol.	Werkstoff / Material					
ROHDE&SCHWARZ	Benennung / Designation: Grundeinheit				Sprache / Lang. de en	Ausl. / E.I. 04.00	Blatt / Sh. 1
Typ / Type EMU					Zeichn Nr. / Drawing No. 1129.9032.00		D
1.Z. used in 1129.9090.00	Datum / Date 12.03.2001	Abteilung / Dept. 1ESK	Name Wn				

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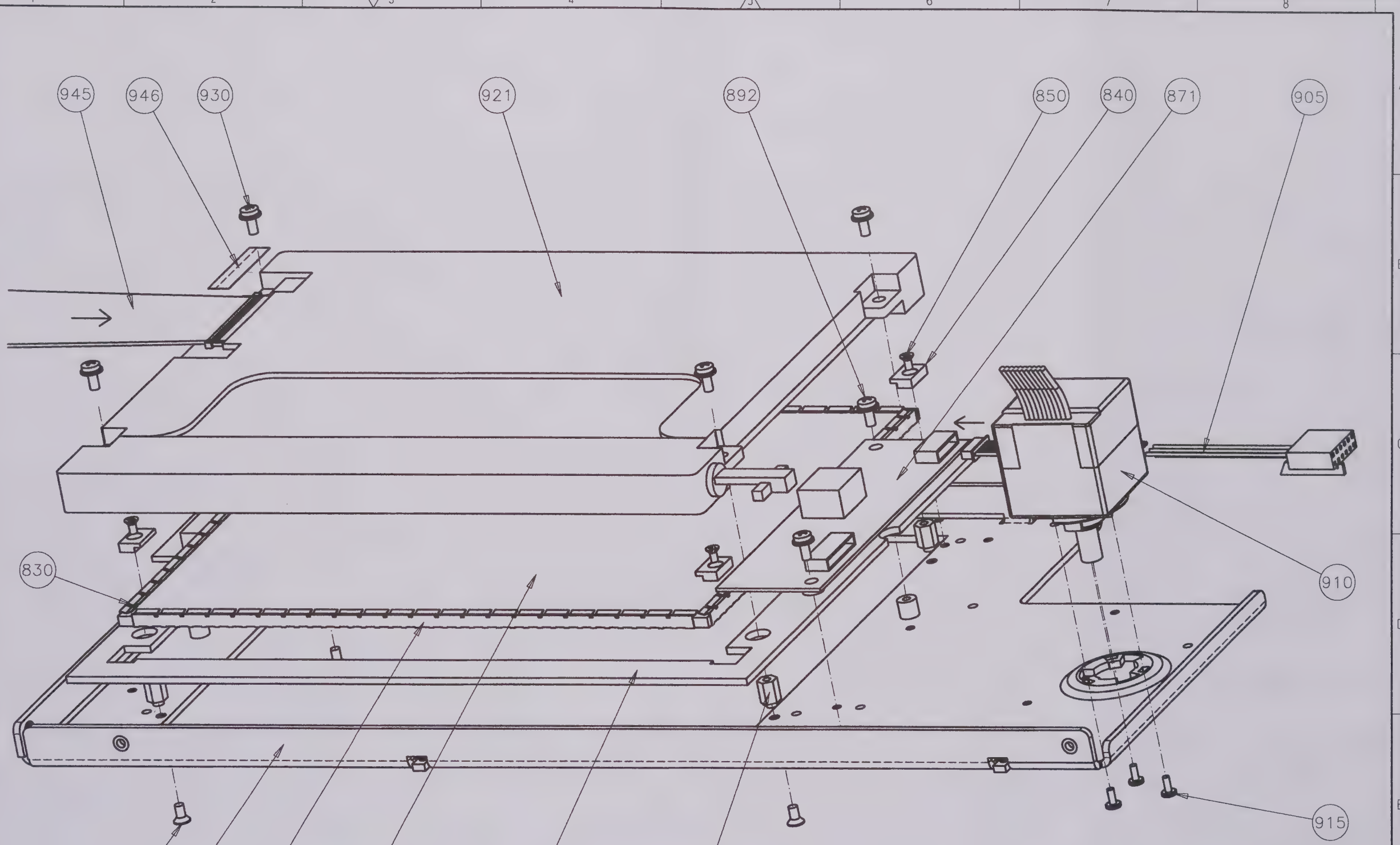

Projektions-methode
Projection Method

VAR 03 fuer Toshiba Display

Maßstab *Scale* 1:1	Toleranz *Tol.*	Werkstoff *Material*			
ROHDE&SCHWARZ	Benennung / *Designation* **Displayeinheit**			Sprache / *Lang.* de en	Aei. / *C.I.* 05.00	Blatt / *Sh.* 2
Typ *Type* EMU				Zeichn.Nr. / *Drawing No.* 1093.4708.01 D	
1.Z. *used in* 1129.9090.01	Datum *Date* 01.03.2001	Abteilung *Dept.* 1ESK	Name *Name* Wn		

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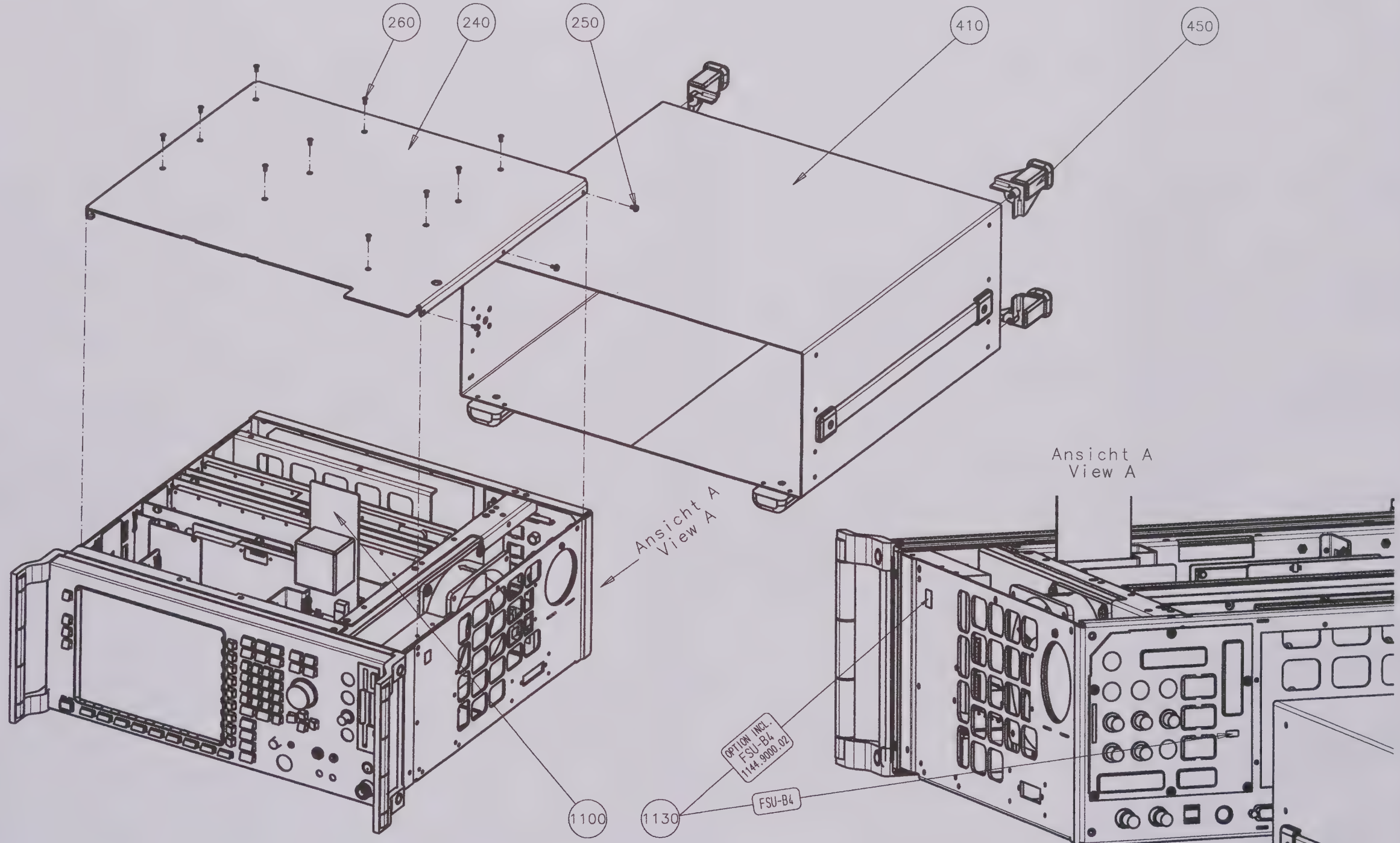

Projektions-methode
Projection Method

Kabel nach Beschriftung montieren.
See connector designation of cables and motherboard for cable mounting.

Maßstab / Scale	Toleranz / Tol.	Werkstoff / Material		
ROHDE&SCHWARZ	Benennung / Designation: Einbauanweisung FSU-B4 / Installation Instruction		Sprache / Lang.: de en	Aei. / C.I.: 02.00	Blatt / Sh.: 1
Typ / Type: FSU-B4			Zeichn.Nr. / Drawing No.: 1144.9017.00		D
i.Z. / used in: 1144.9000.01	Datum / Date: 24.11.2000	Abteilung / Dept.: 1ESK	Name: TF		

ROHDE&SCHWARZ

Block Circuit Diagram

Part List

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Floppy A30

A70 DISPLAY

T10 WANDLER

A60 Hard DISK

W70 W100 W29

W300 W301

A90 FRONT MODULE CONTROLLER

A16 FLEX. SWITCHBOARD

A15 FLEX. SWITCH FOIL

X30 X31 X221

Option FSU-B16 A220 LAN INTERFACE X221

Option FSU-B4 A200 OCXO X200

Option FSP-B10 A210 EXTERNAL GENERATOR X210

FSU-B17

A140 DETECTOR BOARD 1 X142 X140 X141

A160 MW CONVERTER FSU 8 X160

A130 IF FILTER X130

A110 SYNTHESIZER X110

A100 RF CONVERTER X100

A20 POWER SUPPLY X20

LINE IN

W32 X220 LAN

W34 I/Q DATA OUT

W11 IF OUT 20.4 MHZ

W10 IF OUT 404.4 MHZ

W12 VIDEO OUT

W17 REF IN 1...20MHZ

W16 REF OUT 10 MHZ

W6 W21 W3 W4 W5 W7 W19 W20 W18 W8 W9 W15 W14 W13

X180 X260 X150 X170

A10 MOTHERBOARD

X60 IEC

X61 LPT

X62 COM1

X63 VGA

X64 TRIGGER/GATE

X65 SWEEP

X66 MOUSE

X69 USB

X67 X300 X68

IEC 2 FSP-B10

AUX CONTROL FSP-B10

X90 X91 X92

X81 X80 X40 X41 X71 X50 X50 X240 X241 X242 X250 X35 X70

B10 ROTARY PULS GENERATOR

A191 Vol./Phones PHONES Volume

NOISE SOURCE W22

A80 Key Probe Probe Power Probe Power PS2 Keyboard

RF-IN X1 W1 X2

CAL A40 RF ATTENUATOR X3

W3 X1

W50

Option FSU-B25 A50 ELECTRONIC ATTENUATOR

W28 W28 W27

FSU8 FSU3

W2 FSU8 W2 FSU3

E1 FAN

B1 SPEAKER

Legend of line styles:

- FSU 3/8
- FSU 8
- Options

ROHDE&SCHWARZ	Benennung: / Designation: FSU SPECTRUM ANALYZER			Sprache: / Lang.: DE	Aei: / C.I.: 01.00	Blatt: / Sh.: 1+
Typ: / Type: FSU	Datum: / Date: 00-10-23	Abteilung: / Dpt: 1ESK	Name: / Name: REITBOEC	Zeichn. Nr.: / Drawing No.: 1129.9003.01 S		
1. Z.: / used in: 1129.9003.01	TOP/TOP.1					

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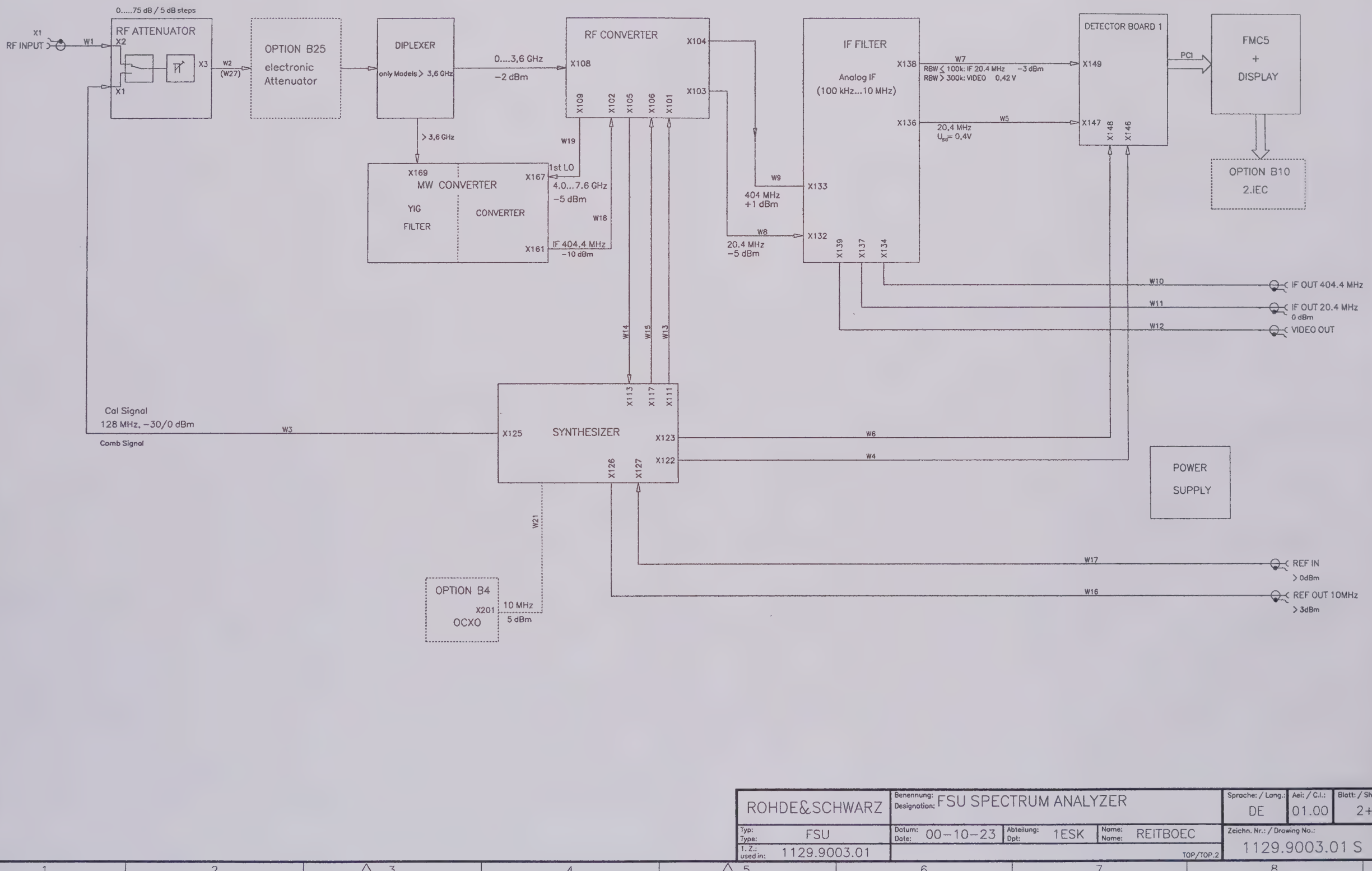

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Typ: / Type: FSU	Datum: / Date: 00–10–23	Abteilung: / Dpt: 1ESK	Name: / Name: REITBOEC	Zeichn. Nr.: / Drawing No.: 1129.9003.01 S		
1. Z.: / used in: 1129.9003.01	TOP/TOP.2					

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RF CONVERTER

2ND IF IN
W18
X102
404,4 MHz
from MW CONVERTER

RF IN
W2/20
X108
20 Hz...3,6 GHz
from ATTENUATOR/ MW CONVERTER

LOWPASS
DIPLEXER
fg = 3,6 GHz
4628,4 MHz...8128,4 MHz
1St LO

X2

1ST MIXER

X12
-44 dB
1ST IF AMP
X15
-33 dB
1ST IF FILTER
BW = 50 MHz
X6
-29 dB
BW 400 MHz
Overload

2ND MIXER
+20dBm
2ND IF AMP
X11
+ 2 dBm

LOGAMP
OVERLOAD DETECTOR
OVERLOAD DETECTOR IF2

2ND IF FILTER
404,4 MHz
BW = 10 MHz
BW = 20 MHz

Step-ATT

IF2out_SW

3RD MIXER
fg = 40 MHz
X13

X103 3RD IF OUT
W8
20,4 MHz
-3 dB to Input
to IF Filter

X101 3RD LO IN
W13
384 MHz
from SYNTHESIZER

X104 2nd IF out
W9
to IF FILTER

X109 LO1 Aux
W19
-5 dBm
to MW CONVERTER

X107 LO1_OUT
+5 dBm

2nd_LOin
W14
X105
+7dBm
from SYNTHESIZER

LO2 AMP
4224 MHz
ISO AMP
-20 dB

SWEEP_LO1
W15
X106
from SYNTHESIZER

+7dBm

2xPD_DIV
PHASEDETECTOR MAIN LOOP

SWEEP FREQUENCY DIVIDER
Data
100EL52

PD
PD
PD
PD

BFP420
4224 MHz
4.2 GHz BANDPASS
4224 MHz
2ND LO
4224 MHz

3xMGA81563
405...3968 MHz
fe < 3,5 GHz
2ND LO OFF

WILKINSON8.gds
SNA176
:4
MGA81563

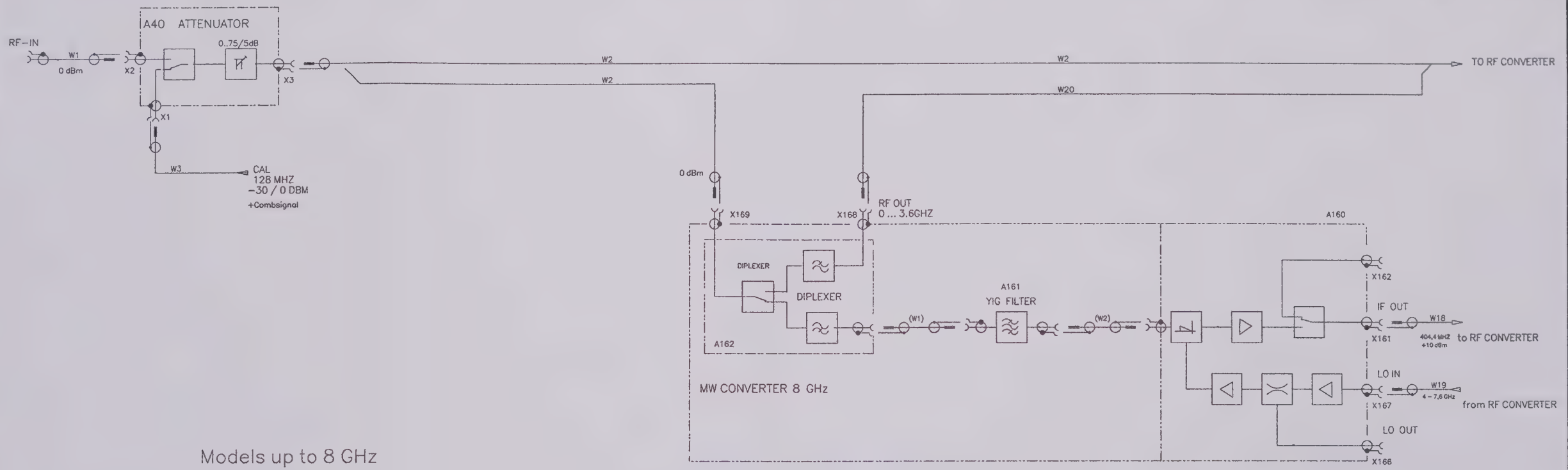
DIVIDER MAIN LOOP
MUX
Data
Data
100EL52

BW: 100...500 kHz
YIG
4,6 ... 8,2 GHz
15 dB
LO AMP
- 2 dB
- 2 dB

ISO AMP
SNA176
ISO AMP
SNA176

1ST LO
4628.4 .. 8228.4 MHz
+ 20 dBm

ROHDE&SCHWARZ	Benennung: / Designation: FSU SPECTRUM ANALYZER		Sprache: / Lang.: DE	Aei: / C.I.: 01.00	Blatt: / Sh.: 3+
Typ: / Type: FSU	Datum: / Date: 00-10-23	Abteilung: / Dpt: 1ESK	Name: / Name: REITBOEC	Zeichn. Nr.: / Drawing No.: 1129.9003.01 S	
1. Z.: / used in: 1129.9003.01	TOP/TOP.3				



Models up to 8 GHz

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ROHDE&SCHWARZ	Benennung: / Designation: FSU SPECTRUM ANALYZER			Sprache: / Lang.: DE	Aei: / C.I.: 01.00	Blatt: / Sh.: 4+
Typ: / Type: FSU	Datum: / Date: 00-10-23	Abteilung: / Dpt: 1ESK	Name: / Name: REITBOEC	Zeichn. Nr.: / Drawing No.: 1129.9003.01 S		
1. Z.: / used in: 1129.9003.01	TOP/TOP.4					

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IF FILTER

X131 IF OUT1 0 DBM

FILTER FFT CAL FFT

XTAL CAL XTAL XTAL CAL XTAL

FILTER 0 CAL LC

Level Offset

CALAMP 1 −3...+3 DB

20.4 MHz IF IN

W8 from RF CONVERTER

X132

SELFTEST/ RF OVERLOAD DETECTOR

STEP GAIN 0/10 dB

CALAMP2 0 ... 6 DB

Freq. Resp.

RBW 200 KHz...3 MHz

FILTER1 CAL LC FILTER2 CAL LC

RBW 10 MHz Path

SELFTEST/ IF OVERLOAD DETECTOR

STEP GAIN −20...+40 DB

STEP FINE 0...12 dB

STEP COARSE −20/−10/0/10/ 20/30/dB

SELFTEST/ IF OVERLOAD DETECTOR

RBW 200 kHz... 3MHz

FILTER3 CAL LC FILTER4 CAL LC

RBW 10 MHz Path

X137 IF OUT2 0 DBM

W11 to REAR PANEL

NOISE FILTER

LOGAMP

20.4 MHz

RBW > 200 kHz

IF 20.4 MHz

X136 IF_COUNT

W5 to DETECTOR BOARD

Video

VIDEO OFFSET

D/A

Σ

10 MHZ

11.6 MHZ

RBW ≤ 100 kHz

LINEAR DETECTOR

only for Calibration

SELFTEST

RBW < 200 kHz: IF 20,4 MHz, − 1 dBm
RBW >= 200 kHz: Video, 0.336V

X138 VIDEO/IF OUT

W7 to DETECTOR BOARD

X139 VIDEO_RP

W12 to REAR PANEL

1 MHZ

DITHER GENERATOR FO = 500 KHZ

AWB. CALAMP 1 −3...+3 DB

AWB. CALAMP 2 −0...+6 DB

NOISE FILTER

LOGAMP

W9 2 nd IF IN

X133 from RF CONVERTER

W10 2 nd IFOUT

X134 to REAR PANEL

WB. STEPGAIN −3...+20 DB/1DB

Demodulator / Audio

AUDIO IN

QUASIPEAK

TO SPEAKER/PHONES

0...40 dB

AM/FM− DEMOD.

AM

FM

COUNTER

PR U D

D/A

from Knob VOLUME

ROHDE&SCHWARZ	Benennung: / Designation: FSU SPECTRUM ANALYZER			Sprache: / Long.: DE	Aei: / C.I.: 01.00	Blatt: / Sh.: 5+
Typ: / Type: FSU	Datum: / Date: 00−10−23	Abteilung: / Dpt: 1ESK	Name: / Name: REITBOEC	Zeichn. Nr.: / Drawing No.: 1129.9003.01 S		
1. Z.: / used in: 1129.9003.01	TOP/TOP.5					

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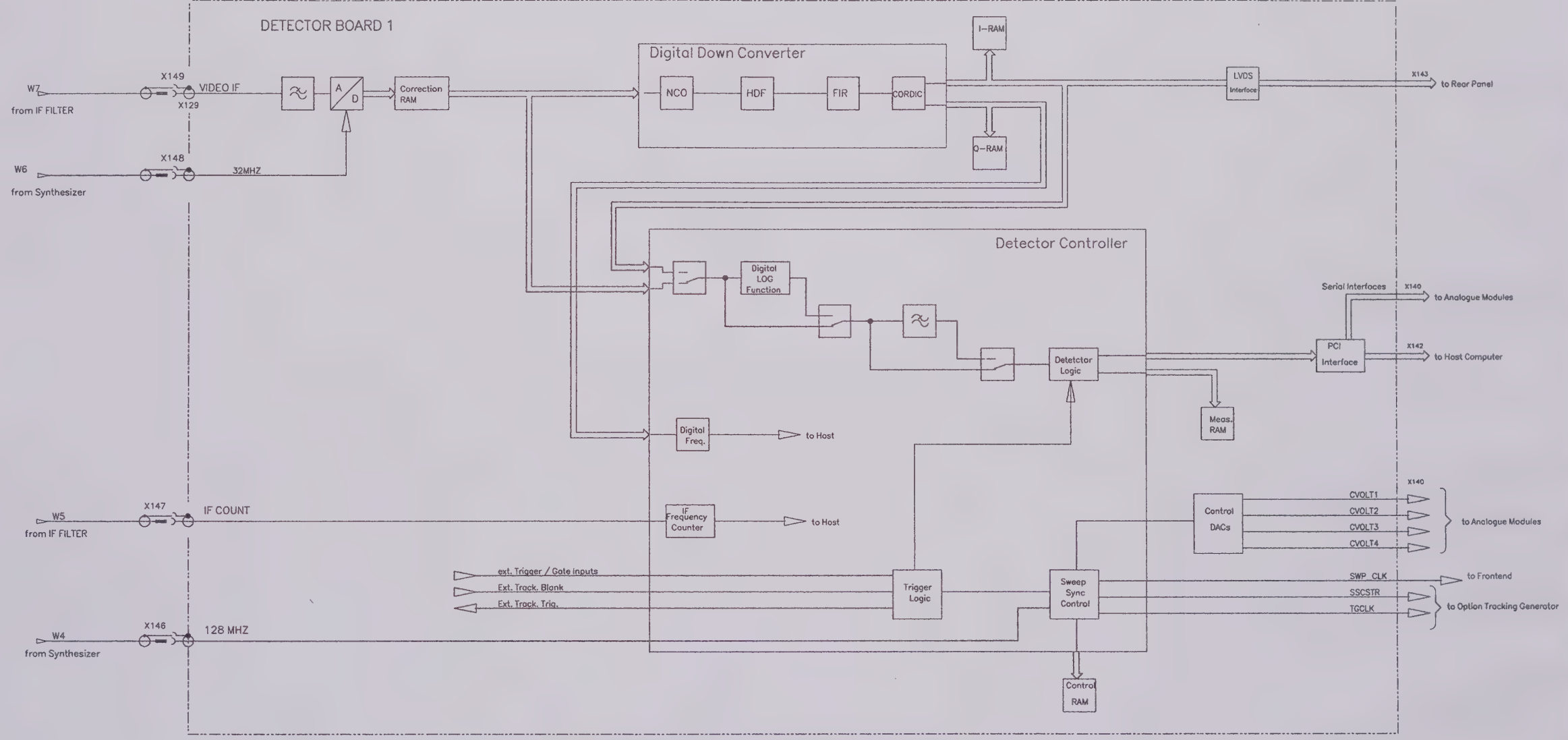

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Typ: / Type: FSU	Datum: / Date: 00-10-23	Abteilung: / Dpt: 1ESK	Name: / Name: REITBOEC	Zeichn. Nr.: / Drawing No.: 1129.9003.01 S		
1. Z.: / used in: 1129.9003.01	TOP/TOP.6					

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SYNTHESIZER

OPTION B4
OCXO

ext. REF in
W17
X127
1..20MHz
+0 dBm...+10 dBm
from REAR PANEL

W21
X128
10 MHz
+3 dBm...+10 dBm
from OCXO OPT

OCXO 10MHz

128MHz

Finecomb
10 KHz
100 KHZ
1 MHz

CalGen
128MHz
0dBm / −30 dBm

MULT

COMB 128

640 MHz

384 MHz

CombGen
640 MHz

384 MHZ
G

SYNCON

Sweep LO1
W15
X117
595..620MHz / +6 dBm
45..20MHz / + 2 dBm
to RF CONVERTER

595...620 MHz
G

N
1

÷11

4224 MHz

f offset

DRO
G

4224 MHz offset

1..4
1

Ref out 1..20MHz
W16
X126
+4dBm....+11dBm
to REAR PANEL

W4
X122
128MHz
−0 dBm
to DETECTOR BOARD 1

W6
X123
128MHz 0 dBm
32MHz −1dBm
to DETECTOR BOARD 1

W3
X125
CAL out 128MHz/0dBm/−30dBm
COMB out
to RF ATTENUATOR

640 MHz
X124
640MHz out
+13dBm

384MHz
W13
X111
3rd LO out +11dBm
to RF CONVERTER

X112
3rd LO out +11dBm

W14
X113
2nd LO out +8 dBm
to RF CONVERTER

X114
2nd LO out +4 dBm

ROHDE&SCHWARZ	Benennung: / Designation: FSU SPECTRUM ANALYZER			Sprache: / Lang.: DE	Aei: / C.I.: 01.00	Blatt: / Sh.: 7−
Typ: / Type: FSU	Datum: / Date: 00−10−23	Abteilung: / Dpt: 1ESK	Name: / Name: REITBOEC	Zeichn. Nr.: / Drawing No.: 1129.9003.01 S		
1. Z.: / used in: 1129.9003.01	TOP/TOP.7					

el. Kennz. *Part*	Benennung *Designation*	Sachnummer *Stock No.*	Hersteller *Manufacturer*	Bezeichnung *Designation*	enthalten in *contained in*
	ACHTUNG EGB /ATTENTION ESD VARIANTENERKLAERUNG VAR03=FSU 3,6 GHZ MOD03=FSU 3,6 GHZ VAR08=FSU 8 GHZ MOD08=FSU 8 GHZ VAR26=FSU 26,5GHZ MOD26=FSU 26,5GHZ				
.	XX ZUGEH.STROML. 1129.9003.01 S	0999.9749.00			1129.9003.01
A10	ED MOTHERBOARD MOTHERBOARD	1130.1960.02			1129.9032.00
A15	SB SCHALTFOLIE F. FSP FLEXIBLE SWITCH FOIL	1093.5140.00	HOF_KRIPPN	1093.5140	1129.9032.00
A16	SB SCHALTMATTE F. FSP FLEX.SWITCHBOARD	1093.5133.00	MAAG	1093.5133	1129.9032.00
A20	GJ NETZTEIL 230W UL/CSA POWER SUPPLY	1091.2320.00	PULS	SN230	1129.9032.00
A30	GM 3.5 FLOPPY DRIVE STD. FLOPPY DRIVE 3.5	0048.4935.00	TEAC	FD–235HF–B291	1129.9032.00
A40	ZE EICHL.(6–STUFIG FSU) Attenuator FSU VAR 03 08	1137.0599.02			1129.9003.01
A40	ZE Eichleitung FSU 26 Attenuator FSU 26 VAR 26	1046.5130.02			1129.9003.01
A60	GM 2.5 FESTPL. 5 GB 2.5 HARDDISK 5 GB	0048.9950.00			1129.9032.00
A70	BP TFT 640X3X480 FARB–LCD 8.4 COLOR LCD MODULE VAR 02 ONLY FOR FSP	0048.6980.00	SHARP	LQ084V1DG21	1093.4708.01
A70	BP 800X600X3 TFT DISPLAY 8.4 COLOR TFT VAR 03 ONLY FOR FSU	0048.8599.00	TOSHIBA	LTM08C351	1093.4708.01
A80	ED KEY–PROBE KEY–PROBE wird zusammen mit Motherboard gefertigt.	1130.2996.02			1129.9003.01
A90	GM FMR 5+ VARIANTE FRONT MOD. CONTROLLER	1091.2789.00	E_E_P_D_	RSFMP NACH SPEC.	1129.9032.00
A100	EE RF CONVERTER RF CONVERTER	1130.1990.02			1129.9003.01
A110	EE SYNTHESIZER SYNTHESISER	1130.2096.02			1129.9003.01
A130	EE IF–FILTER IF–FILTER	1130.2296.02			1129.9003.01
A140	EE DETECTOR BOARD 1	1130.2196.04			1129.9003.01
A160	ZE CONVERTER UNIT(8 GHZ) CONVERTER UNIT (8GHZ) VAR 08	1130.2396.02			1129.9003.01
A160	ZE MW–Converter Unit 26 MW–Converter Unit 26 VAR 26	1130.3240.26			1129.9003.01
A191	ED VOL/PHONES BOARD VOL/PHONES BOARD	1093.7094.02			1129.9003.01
B1	ZE Lautsprecher	1129.9332.00			1129.9003.01
B10	EM DREHIMP.M.BAJON.U.TASTF. ROTARY PULS–GENERATOR	0852.1170.00	ELMA	0852.1170	1093.4708.01
E1	ZM LUEFTER	1091.1001.00			1129.9003.01

el. Kennz. *Part*	Benennung *Designation*	Sachnummer *Stock No.*	Hersteller *Manufacturer*	Bezeichnung *Designation*	enthalten in *contained in*
T10	BV CXA–L0605–VJL DC–AC DC TO AC INVERTER UNIT VAR 02 ONLY FOR FSP	0048.6996.00	TDK	CXA–L0605–VJL	1093.4708.01
T10	BV VNR–08C351–INV DC TO AC INVERTER UNIT VAR 03 ONLY FOR FSU	0048.8760.00	SYSTEMELEK	VNR–08C351–INV	1093.4708.01
W1	DW HF–Kabel_W1 8GHz VAR 03 08	1129.9503.00			1129.9003.01
W1	DW HF–Kabel W1 RF Cable W1 VAR 26	1129.9555.00			1129.9003.01
W2	DW HF–Kabel W2 3.6GHz VAR 03	1129.9510.00			1129.9490.01
W2	DW HF–Kabel W2 8GHz RF CABLE W2 8GHZ VAR 08	1129.9526.00			1129.9490.01
W2	DW HF–Kabel W2 26,5GHz RF Cable W2 26.5GHz VAR 26	1129.9561.00			1129.9490.01
W3	DV HF Kabel W3 RF–Cable W3	1129.9755.00			1129.9749.01
W4	DV HF–Kabel W4 RF–Cable W4	1129.9761.00			1129.9749.01
W5	DV HF–Kabel W5 RF–Cable W5	1129.9778.00			1129.9749.01
W6	DV HF–Kabel W6 RF–Cable W6	1129.9784.00			1129.9749.01
W7	DV HF Kabel W7 RF–Cable W7	1129.9790.00			1129.9749.01
W8	DV HF–Kabel W8 RF–Cable W8	1129.9803.00			1129.9749.01
W9	DV HF–Kabel W9 RF–Cable W9	1129.9810.00			1129.9749.01
W10	DV HF Kabel W10 RF–Cable W10	1129.9826.00			1129.9749.01
W11	DV HF Kabel W11 RF–Cable W11	1129.9832.00			1129.9749.01
W12	DV HF Kabel W12 RF–Cable W12	1129.9849.00			1129.9749.01
W13	DV HF–Kabel W13 RF–Cable W13	1129.9855.00			1129.9749.01
W14	DV HF–Kabel W14 RF–Cable W14	1129.9861.00			1129.9749.01
W15	DV HF–Kabel W15 RF–Cable W15	1129.9878.00			1129.9749.01
W16	DV HF Kabel W16 RF–Cable W16	1129.9884.00			1129.9749.01
W17	DV HF–Kabel W17 RF–Cable W17	1129.9890.00			1129.9749.01
W18	DV HF Kabel W18 RF–Cable W18 VAR 08	1129.9903.00			1129.9749.01
W18	DV HF Kabel W18 RF–CABLE W18 VAR 26	1129.9932.00			1129.9749.01
W19	DW HF–Kabel W19 VAR 08	1129.9549.00			1129.9490.01
W19	DW HF–Kabel W19 RF Cable W19 VAR 26	1129.9578.00			1129.9490.01

el. Kennz. *Part*	Benennung *Designation*	Sachnummer *Stock No.*	Hersteller *Manufacturer*	Bezeichnung *Designation*	enthalten in *contained in*
W20	DW HF–Kabel W20 RF CABLE W20 VAR 08	1129.9532.00			1129.9490.01
W20	DW HF–Kabel W20 RF Cable W20 VAR 26	1129.9584.00			1129.9490.01
W22	DV HF–KABEL W22 RF–Cable W22	1129.9710.00			1129.9749.01
W23	DV HF KABEL W23 RF–CABLE W23 VAR 26	1129.9949.00			1129.9749.01
W29	DY Flachbandleitung Flat Cable W29	1093.5156.00			1129.9032.00
W40	DY FLACHBANDKABEL W40 CABLE 16 PIN VAR 03 08	1130.2515.00			1129.9003.01
W70	DF DISPLAYVERBINDER CABLE VAR 02 ONLY FOR FSP	1091.0911.00	LACON	1091.0911	1093.4708.01
W70	DF DISPLAYVERBINDER L=550 CABLE VAR 03 ONLY FOR FSU	1091.2595.00	MBS	1091.2598	1093.4708.01
W100	DF WANDLERKABEL L=250 CABLE VAR 02 ONLY FOR FSP	1091.0928.00	LACON	1091.0928	1093.4708.01
W100	DF WANDLERKABEL L=350 CABLE VAR 03 ONLY FOR FSU	1091.2589.00	MBS	1091.258	1093.4708.01
W300	DY W300 FLOPPY DATA W300 FLOPPY DATA	1129.9726.00			1129.9032.00
W301	DX Floppy Power Floppy Power	1129.9732.00			1129.9032.00
X1	FJ TESTPORT GEH.ADAPTER ADAPTOR VAR 26	1021.0493.00	ROSENBERGE	04K–529–K00–S3	1129.9003.01

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